AN ANALYSIS OF SOME PERIODIC
BUCKLING OVER AND UNDER
IMPOSED LOAD

Ischinger

AN ANALYSIS OF SOME DIFFERENCES BETWEEN ONE AND TWO-HANDED INDUSTRIAL WORK

A Thesis

Submitted to the Faculty

of

Purdue University

by

Eric Ischinger Jr. [1921-]

In Partial Fulfillment of the

Requirements for the Degree

of

Master of Science

in

Industrial Engineering

June, 1950

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ACKNOWLEDGMENT

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ABSTRACT

In the system of stop watch time study advanced by Dr. M. E. Mundel[1] the rating of an operator's performance is based upon a comparison between the pace or rate of activity of the operator and a standard rate of activity. A correction is then applied for what are now termed allowances and secondary adjustments.[2] One of these secondary adjustments is made for bimanualness or bimanual activity. For the purpose of this discussion a bimanual operation is defined as one requiring the simultaneous symmetrical motion of both hands.

Previous studies[3] conducted at the University of Iowa show a difference in cycle time between one and two handed operations of approximately 30%. The adjustment now applied for bimanual activity is 10% based on the above figure tempered by judgement and experience in application. It was the purpose of this study to substantiate the previous research in part and to determine a more nearly correct value for this adjustment.

It was intended in this experiment to minimize the

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1. M. E. Mundel, Systematic Motion and Time Study; (New York, Prentice Hall, 1947) p. 128.

2. M. E. Mundel, Motion and Time Study Principles and Practice; (New York, Prentice Hall, 1950) Chapter 18 (Manuscript before press.)

3. R. M. Barnes, M. E. Mundel, and J. M. MacKenzie, "Studies of One and Two-Handed Work," (University of Iowa Studies in Engineering, Bulletin 21, 1940).

ABSTRACT

In the system of stop watch time study advanced by Dr. M. E. Mundel[1] the rating of an operator's performance is based upon a comparison between the pace or rate of activity of the operator and a standard rate of activity. A correction is then applied for what are now termed allowances and secondary adjustments.[2] One of these secondary adjustments is made for dimensionless or dimensional activity. For the purpose of this discussion a dimensional operation is defined as one requiring the simultaneous symmetrical motion of both hands.

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error in the previous laboratory study believed attributable to inexperience and laboratory conditions. For that reason the subjects in this study were experienced operators doing industrial jobs requiring bimanual activity. A total of eight operators on five different operations were selected. Each operator performed the operation first bimanually, then with the preferred hand alone and finally with the non-preferred hand. A short practice period was included between each phase.

Each study was recorded on 16 mm. motion picture film with time included by means of having a microchronometer placed in the field of view. This procedure made possible a very accurate determination of cycle time. A sufficient number of cycles were photographed to obtain a statistically reliable mean cycle time for each operation.

From the mean of the cycle times there was calculated a percent increase in cycle time required for bimanual activity over that required using the preferred hand. The mean percent increase in cycle time was found to be 17.852%. Since the percent increase in cycle time is symmetrically distributed about the mean, the mean is the best measure of central tendency.[4] It is concluded then that a value of 18% is more nearly the correct adjustment to be applied for bimanualness.

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4. P. G. Hoel, Introduction to Mathematical Statistics; (New York, Wiley and Sons, Inc., 1947) p. 8, 18.

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4. P. G. Hoel, Introduction to Mathematical Statistics; (New York, Wiley and Sons, Inc., 1954) p. 47. 13.

AN ANALYSIS OF SOME DIFFERENCES BETWEEN ONE AND TWO-HANDED INDUSTRIAL WORK

INTRODUCTION

"Stop watch time study is used to find the amount of time necessary to accomplish a unit of work using a given method under given conditions of work, by a worker possessing a specified amount of skill on the job and a specified aptitude for the job, when working at a pace that will produce, within a unit of time, a specified physical effect upon him."[1]

There are four principal steps in the mechanics of taking a stop watch time study, namely:

1. Recording the method.
2. Recording the time.
3. Rating the operator.
4. Application of allowances and secondary adjustments.

It is a very small portion of the fourth step listed which is the subject of this study.

In the system of stop watch time study[2] advanced by Dr. M. E. Mundel, rating, which is the third step mentioned in the preceding paragraph, is accomplished by relating

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the performance of an operator to a standard by a comparison of pace alone. The fallacy of such a system without secondary adjustments for job difficulty is apparent when one considers the following exaggerated case. Suppose the rate of activity of a worker handling fifty pound weights is compared to that of a man dealing cards as a standard. Due to job difficulty the pace at which the former works cannot possibly approach that rate of activity which is the standard. An adjustment is therefore made to the rating for the degree of job difficulty - in this case the weight handled. In a like manner, but to a lesser degree, an adjustment must be made for bimanual activity.

In studies[3] conducted at Iowa University there was found to be an increase in cycle time of approximately 30% when performing a simple operation bimanually over that needed to perform the operation with only one hand. From experience in the application of the adjustment for bimanualness it has been determined that a value of 30% is too great and an adjustment of 10% is now being used.

An examination of the Iowa studies suggests that the error believed to be included in the results might be attributed to a lack of experience on the part of the operators. The operators were students whose performances were recorded after a minimum of training. Equal training or practice periods were allocated to each phase of

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3. Barnes, Mundel, MacKenzie, Op. Cit.

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the study. The operators performed the operation first with only one hand and then bimanually. Although the operation was a relatively simple one, it is possible that a marked degree of proficiency was attained using only one hand and that the same degree of proficiency was not reached in the bimanual operation.

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PURPOSE

The purpose of this investigation is to determine the adjustment for bimanualness which should be applied in making a stop watch time study when using a pace-rating system.

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The purpose of this investigation is to determine the adjustment for dimensions which should be applied in making a stop watch time study when using a pace-rating system.

PROCEDURE

This experiment was designed primarily to eliminate lack of experience as a factor influencing the results. Operators were selected who had considerable experience or who demonstrated the equivalent in aptitude and proficiency on bimanual jobs in industry. It appears reasonable to conclude that these operators must possess equal skill in using only one hand separately to do the identical job. Any lack of familiarity or awkwardness in performing the job with one hand was minimized by allowing short practice periods for the operators.

In addition it was intended to minimize all variables except those which are uniquely attributable to bimanual activity. Jobs were selected which required a minimum of eye-hand coordination in order to minimize the effect of that variable for which a separate correction is made. The weights of parts handled by the operator were negligible and no part of the cycle was machine paced. It might appear that a wide range of job cycle times is desirable for a study of this kind. However, all but two jobs selected had comparatively short cycle times. A short cycle was characteristic of the jobs from which the selection for this study was made and is typical of a wide variety of bimanual jobs. Eight operators on five different jobs were selected.

Once the operator was selected, the purpose, procedure

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This experiment was designed primarily to eliminate lack of experience as a factor influencing the results. Operators were selected who had considerable experience or who demonstrated the equivalent in aptitude and proficiency on piecework jobs in industry. It appears reasonable to conclude that these operators must possess equal skill in using only one hand separately to do the identical job. Any lack of familiarity or awkwardness in performing the job with one hand was minimized by allowing short practice periods for the operators.

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Once the operator was selected, the subject's procedure

and scope of the study were explained to him. He was instructed to perform each phase of the study using exactly the same method and at the maximum pace which he could attain. He was assured that the motion pictures would not be used by the company in setting standards or in any way which would affect the job either directly or indirectly. The operator was given an opportunity to ask any questions he wished concerning the procedure and objectives of the study. In that way it was attempted to obtain the complete confidence and cooperation of the operator before the study was begun.

The operator first performed the operation bimanually, then with the preferred hand, and finally with the non-preferred hand. A brief practice period was allocated between each phase to enable the operator to become adapted to performing the operation with only one hand. The operator's performance was recorded using a motion picture camera. A sufficient number of cycles were photographed to insure a statistically reliable average cycle time.

The motion pictures were taken on Eastman Kodak Super XX film at 16 frames per second using an Eastmen Kodak Cine Special 16 mm. camera with an f 1.9 lens. Photoflood lights were used to supplement the light normally available to the worker in order to insure satisfactory exposures. A microchronometer was placed in the field of view of the camera in order to provide a measure of time on the film. The film is available for reference in the Motion and Time

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The operator first performed the operation alternately, then with the preferred hand, and finally with the non-preferred hand. A brief practice period was allocated between each phase to enable the operator to become adapted to performing the operation with only one hand. The operator's performance was recorded using a motion picture camera. A sufficient number of cycles were photographed to insure a statistically reliable average cycle time.

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Study Laboratory, Purdue University.

After the film was processed, it was analyzed. For this work, a small, inexpensive, hand-crank operated motion picture projector was used to view the film in a darkened room. The projector was fitted with a heat dispensing adaptor in order that a single frame could be viewed for any length of time without danger of burning the film. The analysis consisted of determining and recording the time required for each cycle. Those cycles were not included which incorporated fumbles or irregularly occuring elements not inherent in the operation. The procedure used in analyzing the film was to pick out a well defined therblig[4] in the operation and record the time value shown on the microchronometer each time that therblig occured. The difference between the successive time values becomes the cycle time which was computed and recorded.

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4. Mundel, Systematic, p. 105.

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4. Mumford, Psychology, p. 108.

DATA

The data for this study consists of a tabulation of the cycle times required by each operator to perform his particular operation bimanually, with the preferred hand, and with the non-preferred hand. These tables, Tables 3 through 10, and job descriptions, Figures 3 through 7, appear in the Appendix.

In each case a sufficient number of cycles were photographed to obtain a statistically reliable mean cycle time for each set of data. In order to substantiate this, one has only to apply the formula:[5]

$$N' = \left(\frac{40\sqrt{N\Sigma t^2 - (\Sigma t)^2}}{\Sigma t} \right)^2$$

where,

N^1 = the number of cycles required to establish the probability that 95 times out of 100 the average cycle time will be within ±5% of the true average representing the observed performance.

N = the number of cycles recorded.

t = the individual cycle times.

For each set of data N^1 was found to be smaller than N, and thus the reliability of the mean at the 5% level was established. The 5% confidence level is an industrially

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5. M. E. Mundel, "How Many Readings in a Time Study," ("Modern Management" August, 1949).

DATA

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$$N_f = \left(\frac{40\sqrt{N\Sigma t^2 - (\Sigma t)^2}}{\Sigma t} \right)^2$$

where,

N_f = the number of cycles required to establish the acceptability that 95 times out of 100 the average cycle time will be within 10% of the true average representing the observed performance.

N = the number of cycles recorded.

t = the individual cycle times.

Σ = the summation of cycles recorded.

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9. R. Brandt, "How Many Readings in a Time Study," (Modern Management" August, 1949).

accepted standard. For mathmatical computations see Table 11.

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RESULTS

The mean cycle time required by each operator for each phase of the operation is recorded in Table 1.

Table 1

MEAN JOB CYCLE TIMES. $\bar{t}$

Operation	Operator	Mean Cycle Time (winks) Bimanually	Preferred Hand	Non-preferred Hand
1	1	36.000	30.893	31.710
	2	34.333	28.210	28.270
	3	40.133	33.051	33.088
2	1	34.895	30.463	31.571
	2	45.357	35.000	40.533
3	1	41.621	38.147	40.625
4	1	250.167	222.818	222.000
5	1	177.452	150.850	156.667

A wink is a 1/2000th part of a minute.

From the above results there was computed the percent increase in cycle time required when performing bimanually and when using the non-preferred hand over that required when using the preferred hand. That information is shown in Table 2.

RESULTS

The mean cycle time required by each operator for each phase of the operation is recorded in Table I.

Table I

MEAN JOB CYCLE TIMES. £

Operation	Operator	Bimanually	Mean Cycle Time (winks) Preferred Hand	Non-preferred Hand
1	1	36.000	30.395	31.710
	2	34.535	28.210	28.270
	3	40.153	33.081	33.056
2	1	34.895	30.463	31.571
	2	43.357	36.000	40.333
3	1	41.631	36.147	40.836
4	1	280.167	222.818	222.000
5	1	177.452	150.880	156.867

A wink is a 1/3000th part of a minute.

From the above results there was computed the percent increase in cycle time required when performing bimanually and when using the non-preferred hand over that required when using the preferred hand. That information is shown in Table 2.

Table 2

PERCENT INCREASE IN CYCLE TIME
OVER PREFERRED HAND TIMES

Operation	Operator	Bimanually	Non-Preferred Hand
1	1	16.531	2.645
	2	21.705	0.213
	3	21.427	0.112
2	1	14.549	3.637
	2	29.591	15.808
3	1	9.107	6.496
4	1	12.274	-0.368
5	1	17.635	3.856

The mean percent increase in cycle time for bimanual operation over that required using the preferred hand alone is determined from the above to be 17.852%.

Table 3

PERCENT INCREASE IN CYCLE TIME
OVER PREFERRED HAND TIMES

Operation	Operator	Minimally	Non-preferred Hand
1	1	16.681	2.645
	2	21.706	0.815
	3	21.427	0.112
2	1	14.849	3.687
	2	28.891	15.809
3	1	9.107	6.496
4	1	12.274	-0.368
5	1	17.635	7.886

The mean percent increase in cycle time for minimal operation over that required using the preferred hand alone is determined from the above to be 17.835%.

DISCUSSION OF RESULTS

Since the cycle times in two of the eight jobs studied were comparatively long, it was believed desirable to see what effect, if any, the length of cycle time had upon the percent increase in cycle time. A simple correlation coefficient between the two was calculated using the formula:

$$r = \frac{N\Sigma xy - \Sigma x \Sigma y}{\sqrt{[N\Sigma x^2 - (\Sigma x)^2][N\Sigma y^2 - (\Sigma y)^2]}}$$

$$= 0.34$$

This correlation coefficient is not significantly different from zero and, therefore, there is little correlation between the two items. To further substantiate this result a line of least squares was calculated for this data and was found to have a slope of +.029. The scattergram for this data is shown in Figure 1. For mathmatical computations see Table 12.

A histogram showing the frequency distribution of the percent increase in cycle times in the class intervals 0-5%, 5-10%, 10-15%, 15-20%, 20-25% and 25-30% is shown in Figure 2. It is clearly evident that the observed values are quite symmetrically distributed about the mean which was found to be 17.852% and that, therefore, the mean value is the best measure of central tendency.[6]

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6. Hoel, loc. cit.

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A histogram showing the frequency distribution of the percent increase in cycle times in the class intervals 0-5%, 5-10%, 10-15%, 15-20%, 20-25% and 25-30% is shown in Figure 2. It is clearly evident that the observed values are quite symmetrically distributed about the mean which was found to be 17.88% and that, therefore, the mean value is the best measure of central tendency.[6]

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6. Hoel, loc. cit.

This value of 18% is clearly significantly different from the 30% which was previously found in the Iowa studies.[7] It is indeed probable that the major contributing factor to that difference is the inexperience of the operators in the previous experiment. That factor has been minimized in the present study. It is concluded that the 18% increase in cycle time is due almost entirely to what might be termed difficulty of coordination in bimanual activity.

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7. Barnes, Mundel, and McKenzie, op. cit.

This value of IBR is clearly significantly different from the 30% which was previously found in the Iowa studies.[7] It is indeed probable that the major contributing factor to that difference is the inexperience of the operators in the previous experiment. That factor has been eliminated in the present study. It is concluded that the IBR increase in cycle time is due almost entirely to what might be termed difficulty of coordination in dimensional activity.

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7. Barnes, Hundal, and Beck, op. cit.

CONCLUSIONS

Since it has been shown that an average operator requires 18% longer to complete a cycle bimanually than when using only one hand, it follows that he must be operating at a pace 18% slower in the former case. Yet in each case he was performing at a rate of activity which represented his maximum effort. Therefore, the rating assigned to the operators performance should be identical in both instances. Using pace alone as a criterion, however, the operator when performing bimanually would be rated 18% lower than when using only the preferred hand. To make the ratings identical, a correction of 18% must be added to the rating assigned to the bimanual operation. Therefore, it is concluded that a secondary adjustment of 18% must be made to compensate for job difficulty in bimanual operations using a pace-rating system of time study.

CONCLUSIONS

Since it has been shown that an average operator requires 18% longer to complete a cycle bimanually than when using only one hand, it follows that he must be operating at a pace 18% slower in the former case. Yet in each case he was performing at a rate of activity which represented his maximum effort. Therefore, the rating assigned to the operators performance should be identical in both instances. Using pace alone as a criterion, however, the operator when performing bimanually would be rated 18% lower than when using only the preferred hand. To make the ratings identical, a correction of 18% must be added to the rating assigned to the bimanual operation. Therefore, it is concluded that a secondary adjustment of 18% must be made to compensate for job difficulty in bimanual operations using a pace-rating system of time study.

APPENDIX

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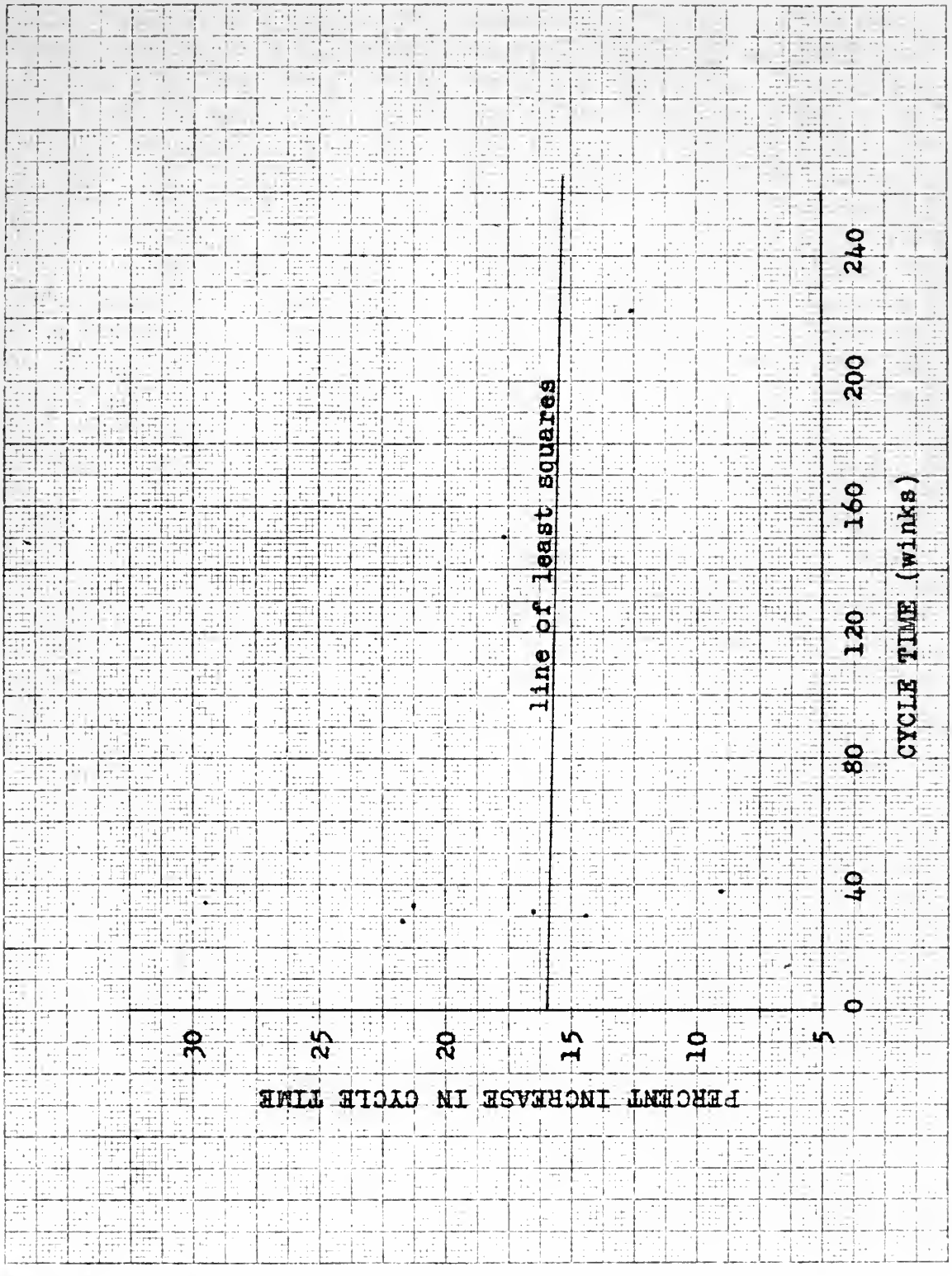

Figure 1. Mean cycle time vs. percent increase in cycle time for bimanual over preferred hand activity.

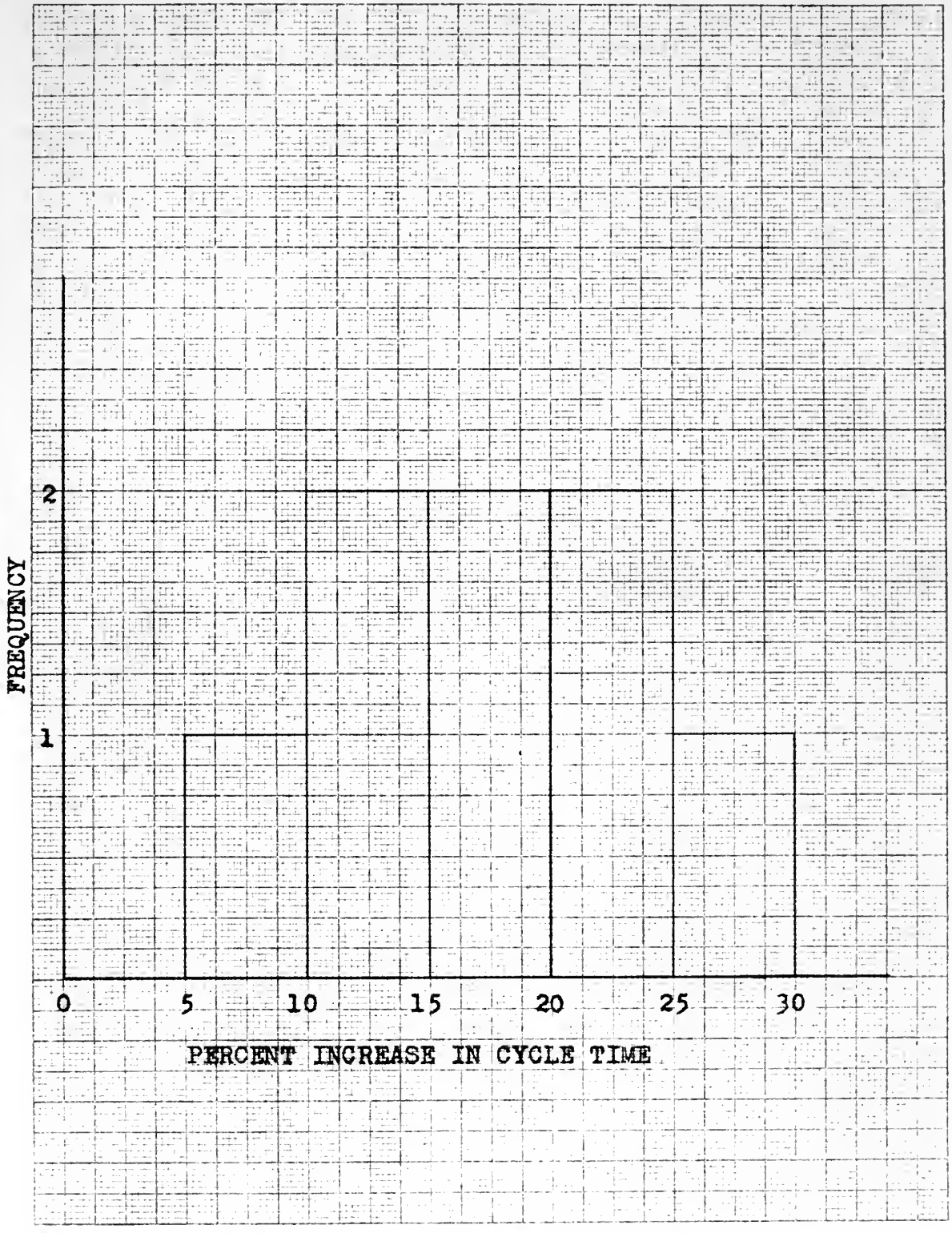

Figure 2. Histogram showing frequency distribution of percent increase in mean cycle time.

Operation: Filling carton with individual boxes of Veto.

Description		
Left Hand	Therblig	Right Hand
Get box of Veto	TE, G, TL	Get box of Veto
Place in carton	P, A, RL	Place in carton

The therblig underlined performed by the right hand is the beginning of the cycle for the purposes of this time analysis.

Figure 3. Workplace for Packaging Veto.

Operation: Filling carbon with individual boxes of Vets.

Description		
Left Hand	Thumbing	Right Hand
Get box of Vets	T. O. T.	Get box of Vets
Place in carbon	P. A. M.	Place in carbon

The thumbing understood performed by the right hand is the beginning of the cycle for the purpose of this time analysis.

Figure 3. Workplace for packaging Vets.

Table 3

VETO PACKAGING #1

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
595		315		784	
630	35	369*		814	30
675	35	013*		845	31
768*		049	36	876	31
806	38	573*		911	35
919*		566	29	132*	
954	35	616*		165	33
000*		665*		200	35
036	36	697*		247*	
069	33	728	31	273	26
230*		867*		300	27
267	37	897	30	330	30
307	40	955*		373*	
351*		030*		411*	
385	34	068*		543	32
423	38	100	32	575	32
572*		144*		606	31
612*		171	27	640	36
650	38	205	34	675	35
682	32	235	30	703	28
729*		265	30	734	31
840*		302	37	761	27
872	32	393*		793	32
912	40	434*		827	34
950	38	464	30	860	33
978	28	575*		022*	
026*		548	33	050	28
315*		574	26	078	28
350	35	620*		116*	
386	36	650	30	154*	
516*		680	30	185	31
601*		710	30	236*	
642	41	740	30	267	31
855*		771	31	300	33
895	40	848*		332	32
940*		888*		074*	
975	35	920	32	413*	
011	36	960*		549*	
		996	36	583	34
		024	28	615	32
		056	32	650	35
		086	30	685	35
		130*		720	35
		160	30	752	32
		193	33	780	28
		226	33	812	32
		323*		840*	
		351	28	871	31
		378	27	046*	
		415*		078	32
				111	33
				150*	
				188*	
				222	34
Σt	792	865		1205	
N	22	28		38	
$\bar{t}$	36.000	30.893		31.710	

T = elapsed time, t = cycle time, N = number of cycles
$\bar{t}$ = mean cycle time. Note: Symbols apply to Tables 3 - 10.
*Cycle time not included because of fumble or irregularly occuring element.

Table 3

VARIETY PACKAGING BY

Removal Ly		Preferred Band		Non-Preferred Band	
T	L	T	L	T	L
569		315		764	
050	05	308*		114	50
675	25	013*		945	41
768*		040	56	870	43
006	86	578*		511	75
819*		986	44	1.58*	
954	58	810*		18E	86
004*		088*		900	80
056	26	672*		847*	
069	35	768	31	977	29
230*		867*		390	27
467	37	887	50	350	70
307	40	058*		772*	
381*		080*		41L*	
385	34	009*		865	52
488	36	100	55	87E	84
425*		144*		806	71
612*		171	24	650	28
050	28	80E	86	575	38
688	42	288	30	703	88
789*		965	80	784	81
840*		712	87	761	87
872	28	4.4*		762	82
910	40	4.4*		892	34
990	23	48*	30	980	32
978	80	1.70*		1.58*	
036*		94L	82	050	84
31.*		47A	28	7E	86
550	01	1.40*		1.5E*	
886	32	640	80	1.64*	
816*		6E1	80	15E	91
001*		7L1	10	438*	
414	41	7A0	70	84.7	81
818*		7..	72	405	32
089	60	8..		252	22
940*		1.8*		074*	
978	33	920	78	41.*	
072	36	960*		8A8*	
		0.6*	94	885	74
		0.8*	42	01.6	14
		0.E*	42	650	44
		0.E*	42	05A	44
		1.0*	42	7.0	44
		1.0*	42	70E	44
		1.0*	42	72E	44
		1.0*	42	75E	44
		1.0*	42	77E	44
		1.0*	42	79E	44
		1.0*	42	7AE	44
		1.0*	42	7CE	44
		1.0*	42	7EE	44
		1.0*	42	80E	44
		1.0*	42	82E	44
		1.0*	42	84E	44
		1.0*	42	86E	44
		1.0*	42	88E	44
		1.0*	42	8AE	44
		1.0*	42	8CE	44
		1.0*	42	8EE	44
		1.0*	42	90E	44
		1.0*	42	92E	44
		1.0*	42	94E	44
		1.0*	42	96E	44
		1.0*	42	98E	44
		1.0*	42	9AE	44
		1.0*	42	9CE	44
		1.0*	42	9EE	44
		1.0*	42	A0E	44
		1.0*	42	A2E	44
		1.0*	42	A4E	44
		1.0*	42	A6E	44
		1.0*	42	A8E	44
		1.0*	42	AAE	44
		1.0*	42	ACE	44
		1.0*	42	AEE	44
		1.0*	42	B0E	44
		1.0*	42	B2E	44
		1.0*	42	B4E	44
		1.0*	42	B6E	44
		1.0*	42	B8E	44
		1.0*	42	BAE	44
		1.0*	42	BCE	44
		1.0*	42	BEE	44
		1.0*	42	C0E	44
		1.0*	42	C2E	44
		1.0*	42	C4E	44
		1.0*	42	C6E	44
		1.0*	42	C8E	44
		1.0*	42	CAE	44
		1.0*	42	CCE	44
		1.0*	42	CEE	44
		1.0*	42	D0E	44
		1.0*	42	D2E	44
		1.0*	42	D4E	44
		1.0*	42	D6E	44
		1.0*	42	D8E	44
		1.0*	42	DAE	44
		1.0*	42	DCE	44
		1.0*	42	DEE	44
		1.0*	42	E0E	44
		1.0*	42	E2E	44
		1.0*	42	E4E	44
		1.0*	42	E6E	44
		1.0*	42	E8E	44
		1.0*	42	EAE	44
		1.0*	42	ECE	44
		1.0*	42	EEE	44
		1.0*	42	F0E	44
		1.0*	42	F2E	44
		1.0*	42	F4E	44
		1.0*	42	F6E	44
		1.0*	42	F8E	44
		1.0*	42	FAE	44
		1.0*	42	FCE	44
		1.0*	42	FEE	44

Table 4

VETO PACKAGING #2

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
210*		380		745	
253*		406	26	770	25
293	40	456*		793	23
327	34	509*		818	25
377*		535	26	847	29
473*		558	23	860*	
510	37	591	33	885	25
549	39	621	30	055*	
587	38	652	31	095*	
622	35	743*		125	30
658	36	770	27	158	33
753*		797	27	183	25
792	39	830	33	208	25
830	38	865	35	245	37
869	39	897	32	269	24
911*		936*		294	25
948	37	964	28	376*	
033*		985	21	405	29
065	32	008	23	434	29
099	34	037	29	463	29
158*		059*		493	30
187	29	092	33	528	35
218	31	192*		560	32
300*		220	28	586	26
334	34	968*		612	26
376*		352*		640	28
410	34	380	28	668	28
442	32	411	31	695	27
469	27	436	25	787*	
550*		460	24	826*	
580	30	490	30	856	30
622*		520	30	885	29
659	37	552	32	966*	
693	34	638*		005*	
728	35	664	26	034	29
825*		690	26	067	33
857	32	740*		110*	
895	38	785*		148*	
934	39	828*		177	29
962	28	867*		296*	
990	28	946*		225	29
083*		974	28	254	29
122	39	998	24	284	30
157	35	085*		324*	
193	36	111	26	452	28
223	30	142	31	480	28
250	27	172	30	507	27
		202	30	532	25
		234	32	557	25
		264	30	587	30
		291	27		
		317	26		
		361*			
		386	25		
		412	26		
Σt	1133		1072		1046
N	33		38		37
$\bar{t}$	34.333		28.210		28.270

*Cycle time not included because of fumble or irregularly occuring element.

Numerals		Preferred items		Non-preferred items	
I	S	I	S	I	S
210*		280		748	
252*		106		772	28
265	40	456*		782	82
387	24	809*		218	20
3774*		588	12	947	20
4758*		688	12	660*	
810	27	801	21	808	8
849	29	621	20	068*	
887	28	682	21	068*	
622	26	742*		128	3
188	28	770	27	186	3
758*		717	27	188	28
708	38	830	29	207	16
880	28	868	28	441	27
869	80	687	21	460	24
812*		82*		824	25
940	27	804	98	378*	
028*		868	21	406	27
068	54	068	24	424	26
060	34	417	20	469	29
138*		38*		482	30
187	28	[illegible]	1	880	28
218	21	138*		880	32
230*		[illegible]	2	846	26
2*4	14	868*		842	24
270*		422*		840	24
471	14	380	22	868	28
442	12	[illegible]	21	868	27
468	24	488	1	728*	
8800*		[illegible]	14	748*	
880		[illegible]	22	878	2
8228*		[illegible]	28	888	28
878	27	[illegible]	1*	[illegible]	
888	24	[illegible]		[illegible]	
708	1	[illegible]	2	[illegible]	
8*0		[illegible]	2*	[illegible]	
887	22	[illegible]		[illegible]	
828	22	[illegible]		[illegible]	
824	22	[illegible]		[illegible]	
8*0		[illegible]		[illegible]	
8*0	20	[illegible]		[illegible]	
8*8	28	[illegible]		[illegible]	
8*8		[illegible]		[illegible]	
8*8		[illegible]		[illegible]	
8*8

Table 5

VETO PACKAGING #3

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
265*		142*		227*	
308	43	193*		251	24
347	39	246*		282	31
403*		304*		324*	
446	43	337	33	356	32
555*		376	39	566*	
590	35	426*		598	32
631	41	486*		632	34
670	39	531*		666	34
707	37	562	31	699	33
750	43	623*		742*	
837*		670*		770	28
877	40	705	35	799	29
938*		737	32	830	31
985	47	450*		863	33
049*		492	42	894	31
084	35	528	36	043*	
201*		565	37	075	32
237	36	635*		108	33
275	38	759*		142	34
346*		789	30	175	33
384	38	813	24	215	40
422	38	843	30	249	34
547*		876	33	280	31
586	39	962*		314	34
624	38	992	30	345	31
664	40	025	33	376	31
708	44	064	39	428*	
747	39	094	30	573*	
863*		130	36	613	40
900	37	172	42	666*	
938	38	202	30	696	30
977	39	237	35	736	40
015	38	270	33	767	31
054	39	300	30	804	37
166*		330	30	836	32
206	40	443*		878	42
255	49	470	27	921	43
328*		496	26	958	37
367	39	527	31	989	31
415	48	560	33	145*	
507*		596	36	174	29
552	45	628	32	202	28
		659	31	248*	
		687	28		
		715	28		
		757	42		
		782	25		
		899*			
		930	31		
		961	31		
		004	43		
		046	42		
		092*			
		125	33		
Σt	1204		1289		1125
N	30		39		34
$\bar{t}$	40.133		33.051		33.088

*Cycle time not included because of fumble or irregularly occuring element.

Table E

WERO RADIATRON 4C

Dimmunity		Dimmunity		Dimmunity	
T	C	T	C	T	C
3685*		1124*		1547*	
3096	4C	1464*		2C1	K
3447	3C	2464*		2C2	3I
4C3*		3C34*		2C4*	
446	4C	3C7	2C	2C6*	
585*		3C8	3C	2C8*	
860	7C	4C2*		2D2	3C
631	4I	4C4*		2D4	3C
870	3C	5C2*		2D6	2I
707	3I	5C8	2I	2D8*	
720	4C	6C2*		2E2	2C
837*		6V0*		2E4	2C
877	4O	7C2	2E	2E6*	
65C*		7C4	2C	2E8	2C
885	4I	8C2	2C	2F2	2C
C49*		8C4	2C	2F4*	
08A	3O	8C6	2C	2F6	2C
201*		8C8	2C	2F8	2C
897	3C	9C2*		2G2	2C
278	3E	9C4	2C	2G4	2C
74C*		9C6	2C	2G6*	
754	3O	9C8	2C	2G8	2C
42E	3C	A02*		2H2	2C
84V*		A04	2C	2H4	2C
5EO	3C	A06	2C	2H6	2C
654	2E	A08	2C	2H8	2C
66A	4O	A2C*		2I2	2C
7U8	4C	A24	2C	2I4	2C
7A7	3O	A26	2C	2I6	2C
8C3*		A28	2C	2I8	2C
90C	3I	A3C*		2J2	2C
938	3E	A32	2C	2J4	2C
977	3O	A34	2C	2J6	2C
01E	3E	A36	2C	2J8	2C
094	3O	A38	2C	2K2	2C
18C*		A4C*		2K4	2C
22E	4O	A42	2C	2K6	2C
25E	4O	A44	2C	2K8	2C
27E*		A46	2C	2L2	2C
2C7*	2C	A48	2C	2L4	2C
2C9	2C	A5C*		2L6	2C
2D1	2C	A52	2C	2L8	2C
2D3	2C	A54	2C	2M2	2C
2D5	2C	A56	2C	2M4	2C
2D7	2C	A58	2C	2M6	2C
2D9	2C	A6C*		2M8	2C
2E1	2C	A62	2C	2N2	2C
2E3	2C	A64	2C	2N4	2C
2E5	2C	A66	2C	2N6	2C
2E7	2C	A68	2C	2N8	2C
2E9	2C	A7C*		2O2	2C
2F1	2C	A72	2C	2O4	2C
2F3	2C	A74	2C	2O6	2C
2F5	2C	A76	2C	2O8	2C
2F7	2C	A78	2C	2P2	2C
2F9	2C	A8C*		2P4	2C
2G1	2C	A82	2C	2P6	2C
2G3	2C	A84	2C	2P8	2C
2G5	2C	A86	2C	2Q2	2C
2G7	2C	A88	2C	2Q4	2C
2G9	2C	A9C*		2Q6	2C
2H1	2C	A92	2C	2Q8	2C
2H3	2C	A94	2C	2R2	2C
2H5	2C	A96	2C	2R4	2C
2H7	2C	A98	2C	2R6	2C
2H9	2C	B2C*		2R8	2C
2I1	2C	B22	2C	2S2	2C
2I3	2C	B24	2C	2S4	2C
2I5	2C	B26	2C	2S6	2C
2I7	2C	B28	2C	2S8	2C
2I9	2C	B3C*		2T2	2C
2J1	2C	B32	2C	2T4	2C
2J3	2C	B34	2C	2T6	2C
2J5	2C	B36	2C	2T8	2C
2J7	2C	B38	2C	2U2	2C
2J9	2C	B4C*		2U4	2C
2K1	2C	B42	2C	2U6	2C
2K3	2C	B44	2C	2U8	2C
2K5	2C	B46	2C	2V2	2C
2K7	2C	B48	2C	2V4	2C
2K9	2C	B5C*		2V6	2C
2L1	2C	B52	2C	2V8	2C
2L3	2C	B54	2C	2W2	2C
2L5	2C	B56	2C	2W4	2C
2L7	2C	B58	2C	2W6	2C
2L9	2C	B6C*		2W8	2C
2M1	2C	B62	2C	2X2	2C
2M3	2C	B64	2C	2X4	2C
2M5	2C	B66	2C	2X6	2C
2M7	2C	B68	2C	2X8	2C
2M9	2C	B7C*		2Y2	2C
2N1	2C	B72	2C	2Y4	2C
2N3	2C	B74	2C	2Y6	2C
2N5	2C	B76	2C	2Y8	2C
2N7	2C	B78	2C	2Z2	2C
2N9	2C	B8C*		2Z4	2C
2O1	2C	B82	2C	2Z6	2C
2O3	2C	B84	2C	2Z8	2C
2O5	2C	B86	2C		
2O7	2C	B88	2C		
2O9	2C	B9C*			
2P1	2C	B92	2C		
2P3	2C	B94	2C		
2P5	2C	B96	2C		
2P7	2C	B98	2C		
2P9	2C	C2C*			
2Q1	2C	C22	2C		
2Q3	2C	C24	2C		
2Q5	2C	C26	2C		
2Q7	2C	C28	2C		
2Q9	2C	C3C*			
2R1	2C	C32	2C		
2R3	2C	C34	2C		
2R5	2C	C36	2C		
2R7	2C	C38	2C		
2R9	2C	C4C*			
2S1	2C	C42	2C		
2S3	2C	C44	2C		
2S5	2C	C46	2C		
2S7	2C	C48	2C		
2S9	2C	C5C*			
2T1	2C	C52	2C		
2T3	2C	C54	2C		
2T5	2C	C56	2C		
2T7	2C	C58	2C		
2T9	2C	C6C*			
2U1	2C	C62	2C		
2U3	2C	C64	2C		
2U5	2C	C66	2C		
2U7	2C	C68	2C		
2U9	2C	C7C*			
2V1	2C	C72	2C		
2V3	2C	C74	2C		
2V5	2C	C76	2C		
2V7	2C	C78	2C		
2V9	2C	C8C*			
2W1	2C	C82	2C		
2W3	2C	C84	2C		
2W5	2C	C86	2C		
2W7	2C	C88	2C		
2W9	2C	C9C*			
2X1	2C	C92	2C		
2X3	2C	C94	2C		
2X5	2C	C96	2C		
2X7	2C	C98	2C		
2X9	2C	D2C*			
2Y1	2C	D22	2C		
2Y3	2C	D24	2C		
2Y5	2C	D26	2C		
2Y7	2C	D28	2C		
2Y9	2C	D3C*			
2Z1	2C	D32	2C		
2Z3	2C	D34	2C		
2Z5	2C	D36	2C		
2Z7	2C	D38	2C		
2Z9	2C	D4C*			
		D42	2C		
		D44	2C		
		D46	2C		
		D48	2C		
		D5C*			
		D52	2C		
		D54	2C		
		D56	2C		
		D58	2C		
		D6C*			
		D62	2C		
		D64	2C		
		D66	2C		
		D68	2C		
		D7C*			
		D72	2C		
		D74	2C		
		D76	2C		
		D78	2C		
		D8C*			
		D82	2C		
		D84	2C		
		D86	2C		
		D88	2C		
		D9C*			
		D92	2C		
		D94	2C		
		D96	2C		
		D98	2C		
		E2C*			
		E22	2C		
		E24	2C		
		E26	2C		
		E28	2C		
		E3C*			
		E32	2C		
		E34	2C		
		E36	2C		
		E38	2C		
		E4C*			
		E42	2C		
		E44	2C		
		E46	2C		
		E48	2C		
		E5C*			
		E52	2C		
		E54	2C		
		E56	2C		
		E58	2C		
		E6C*			
		E62	2C		
		E64	2C		
		E66	2C		
		E68	2C		
		E7C*			
		E72	2C		
		E74	2C		
		E76	2C		
		E78	2C		
		E8C*			
		E82	2C		
		E84	2C		
		E86	2C		
		E88	2C		
		E9C*			
		E92	2C		
		E94	2C		
		E96	2C		
		E98	2C		
		F2C*			
		F22	2C		
		F24	2C		
		F26	2C		
		F28	2C		
		F3C*			
		F32	2C		
		F34	2C		
		F36	2C		
		F38	2C		
		F4C*			
		F42	2C		
		F44	2C		
		F46	2C		
		F48	2C		
		F5C*			
		F52	2C		
		F54	2C		
		F56	2C		
		F58	2C		
		F6C*			
		F62	2C		
		F64	2C		
		F66	2C		
		F68	2C		
		F7C*			
		F72	2C		
		F74	2C		
		F76	2C		
		F78	2C		
		F8C*			
		F82	2C		
		F84	2C		
		F86	2C		
		F88	2C		
		F9C*			
		F92	2C		
		F94	2C		
		F96	2C		
		F98	2C		
		G2C*			
		G22	2C		
		G24	2C		
		G26	2C		
		G28	2C		
		G3C*			
		G32	2C		
		G34	2C		
		G36	2C		
		G38	2C		
		G4C*			
		G42	2C		
		G44	2C		
		G46	2C		
		G48	2C		
		G5C*			
		G52	2C		
		G54	2C		
		G56	2C		
		G58	2C		
		G6C*			
		G62	2C		
		G64	2C		
		G66	2C		
		G68	2C		
		G7C*			
		G72	2C		
		G74	2C		
		G76	2C		
		G78	2C		
		G8C*			
		G82	2C		
		G84	2C		
		G86	2C		
		G88	2C		
		G9C*			
		G92	2C		
		G94	2C		
		G96	2C		
		G98	2C		
		H2C*			
		H22	2C		
		H24	2C		
		H26	2C		
		H28	2C		
		H3C*			
		H32	2C		
		H34	2C		
		H36	2C		
		H38	2C		
		H4C*			
		H42	2C		
		H44	2C		
		H46	2C		
		H48	2C		
		H5C*			
		H52	2C		
		H54	2C		
		H56	2C		
		H58	2C		
		H6C*			
		H62	2C		
		H64	2C		
		H66	2C		
		H68	2C		
		H7C*			
		H72	2C		
		H74	2C		
		H76	2C		
		H78	2C		
		H8C*			
		H82	2C		
		H84	2C		
		H86	2C		
		H88	2C		
		H9C*			
		H92	2C		
		H94	2C		
		H96	2C		
		H98	2C		
		I2C*			
		I22	2C		
		I24	2C		
		I26	2C		
		I28	2C		
		I3C*			
		I32	2C		
		I34	2C		
		I36	2C		
		I38	2C		
		I4C*			
		I42	2C		
		I44	2C		
		I46	2C		
		I48	2C		
		I5C*			
		I52	2C		
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		I58	2C		
		I6C*			
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		I68	2C		
		I7C*			
		I72	2C		
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		I78	2C		
		I8C*			
		I82	2C		
		I84	2C		
		I86	2C		
		I88	2C		
		I9C*			
		I92	2C		
		I94	2C		
		I96	2C		
		I98	2C		
		J2C*			
		J22	2C		
		J24	2C		
		J26	2C		
		J28	2C		
		J3C*			
		J32	2C		
		J34	2C		
		J36	2C		
		J38	2C		
		J4C*			
		J42	2C		
		J44	2C		
		J46	2C		
		J48	2C		
		J5C*			
		J52	2C		
		J54	2C		
		J56	2C		
		J58	2C		
		J6C*			
		J62	2C		
		J64	2C		
		J66	2C		
		J68	2C		
		J7C*			
		J72	2C		
		J74	2C		
		J76	2C		
		J78	2C		
		J8C*			
		J82	2C		
		J84	2C		
		J86	2C		
		J88	2C		
		J9C*			
		J92	2C		
		J94	2C		
		J96	2C		
		J98	2C		
		K2C*			
		K22	2C		
		K24	2C		
		K26	2C		
		K28	2C		
		K3C*			
		K32	2C		
		K34	2C		
		K36	2C		
		K38	2C		
		K4C*			
		K42	2C		
		K44	2C		
		K46	2C		
		K48	2C		
		K5C*			
		K52	2C		
		K54	2C		
		K56	2C		
		K58	2C		
		K6C*			
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		K66	2C		
		K68	2C		
		K7C*			
		K72	2C		
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		K76	2C		
		K78	2C		
		K8C*			
		K82	2C		
		K84	2C		
		K86	2C		
		K88	2C		
		K9C*			
		K92	2C		
		K94	2C		
		K96	2C		
		K98	2C		
		L2C*			
		L22	2C		
		L24	2C		
		L26	2C		
		L28	2C		
		L3C*			
		L32	2C		
		L34	2C		
		L36	2C		
		L38	2C		
		L4C*			
		L42	2C		
		L44	2C		
		L46	2C		
		L48	2C		
		L5C*			
		L52	2C		
		L54	2C		
		L56	2C		
		L58	2C		
		L6C*			
		L62	2C		
		L64	2C		
		L66	2C		
		L68	2C		
		L7C*			
		L72	2C		
		L74	2C		
		L76	2C		
		L78	2C		
		L8C*			
		L82	2C		
		L84	2C		
		L86	2C		
		L88	2C		
		L9C*			
		L92	2C		
		L94	2C		
		L96	2C		
		L98	2C		
		M2C*			
		M22	2C		
		M24	2C		
		M26	2C		
		M28	2C		
		M3C*			
		M32	2C		
		M34	2C		
		M36	2C		
		M38	2C		
		M4C*			
		M42	2C		
		M44	2C		
		M46	2C		
		M48	2C		
		M5C*			
		M52	2C		
		M54	2C		
		M56	2C		
		M58	2C		
		M6C*			
		M62	2C		
		M64	2C		
		M66	2C		
		M68	2C		
		M7C*			
		M72	2C		
		M74	2C		
		M76	2C		
		M78	2C		
		M8C*			
		M82	2C		
		M84	2C		
		M86	2C		
		M88	2C		
		M9C*			
		M92	2C		
		M94	2C		
		M96	2C		
		M98	2C		
		N2C*			
		N22	2C		
		N24	2C		
		N26	2C		
		N28	2C		
		N3C*			
		N32	2C		
		N34	2C		
		N36	2C		
		N38	2C		
		N4C*			
		N42	2C		
		N44	2C		
		N46	2C		
		N48	2C		
		N5C*			
		N52	2C		
		N54	2C		
		N56	2C		
		N58	2C		
		N6C*			
		N62	2C		
		N64	2C		
		N66	2C		
		N68	2C		
		N7C*			
		N72	2C		
		N74	2C		
		N76	2C		
		N78	2C		
		N8C*			
		N82	2C		
		N84	2C		
		N86	2C		
		N88	2C		
		N9C*			
		N92	2C		
		N94	2C		
		N96	2C		
		N98	2C		
		O2C*			
		O22	2C		
		O24	2C		
		O26	2C		
		O28	2C		
		O3C*			
		O32	2C		
		O34	2C		
		O36	2C		
		O38	2C		
		O4C*			
		O42	2C		
		O44	2C		
		O46	2C		
		O48	2C		
		O5C*			
		O52	2C		
		O54	2C		
		O56	2C		
		O58	2C		
		O6C*			
		O62	2C		
		O64	2C		
		O66	2C		
		O68	2C		
		O7C*			
		O72	2C		
		O74	2C		
		O76	2C		
		O78	2C		
		O8C*			
		O82	2C		
		O84	2C		
		O86	2C		
		O88	2C		
		O9C*			
		O92	2C		
		O94	2C		
		O96	2C		
		O98	2C		
		P2C*			
		P22	2C		
		P24	2C		
		P26	2C		
		P28	2C		
		P3C*			
		P32	2C		
		P34	2C		
		P36	2C		
		P38	2C		
		P4C*			
		P42	2C		
		P44	2C		
		P46	2C		
		P48	2C		
		P5C*			
		P52	2C		
		P54	2C		
		P56	2C		
		P58	2C		
		P6C*			
		P62	2C		
		P64	2C		
		P66	2C		
		P68	2C		
		P7C*			
		P72	2C		
		P74	2C		
		P76	2C		
		P78	2C		
		P8C*			
		P82	2C		
		P84	2C		
		P86	2C		
		P88	2C		
		P9C*			
		P92	2C		
		P94	2C		
		P96	2C		
		P98	2C		
		Q2C*			
		Q22	2C		
		Q24	2C		
		Q26	2C		
		Q28	2C		
		Q3C*			
		Q32	2C		
		Q34	2C		
		Q36	2C		
		Q38	2C		
		Q4C*			
		Q42	2C		
		Q44	2C		
		Q46	2C		
		Q48	2C		
		Q5C*			
		Q52	2C		
		Q54	2C		
		Q56	2C		
		Q58	2C		
		Q6C*			
		Q62	2C		
		Q64	2C		
		Q66	2C		
		Q68	2C		
		Q7C*			
		Q72	2C		
		Q74	2C		
		Q76	2C		
		Q78	2C		
		Q8C*			
		Q82	2C		
		Q84	2C		
		Q86	2C		
		Q88	2C		
		Q9C*			
		Q92	2C		
		Q94	2C		
		Q96	2C		
		Q98	2C		
		R2C*			
		R22	2C		
		R24	2C		
		R26	2C		
		R28	2C		
		R3C*			
		R32	2C		
		R34	2C		
		R36	2C		
		R38	2C		
		R4C*			
		R42	2C		
		R44	2C		
		R46	2C		
		R48	2C		
		R5C*			
		R52	2C		
		R54	2C		
		R56	2C		
		R58	2C		
		R6C*			
		R62	2C		
		R64	2C		
		R66	2C		
		R68	2C		
		R7C*			
		R72	2C		
		R74	2C		
		R76	2C		
		R78	2C		
		R8C*			
		R82	2C		
		R84	2C		
		R86	2C		
		R88	2C		
		R9C*			
		R92	2C		
		R94	2C		
		R96	2C		
		R98	2C		
		S2C*			
		S22	2C		
		S24	2C		
		S26	2C		
		S28	2C		
		S3C*			
		S32	2C		
		S34	2C		
		S36	2C		
		S38	2C		
		S4C*			
		S42	2C		
		S44	2C		
		S46	2C		
		S48	2C		
		S5C*			
		S52	2C		
		S54	2C		
		S56	2C		
		S58	2C		
		S6C*			
		S62	2C		
		S64	2C		
		S66	2C		
		S68	2C		
		S7C*			
		S72	2C		
		S74	2C		
		S76	2C		
		S78	2C		
		S8C*			
		S82	2C		
		S84	2C		
		S86	2C		
		S88	2C		
		S9C*			
		S92	2C		
		S94	2C		
		S96	2C		
		S98	2C		
		T2C*			
		T22	2C		
		T24	2C		
		T26	2C		
		T28	2C		
		T3C*			
		T32	2C		
		T34	2C		
		T36	2C		
		T38	2C		
		T4C*			
		T42	2C		
		T44	2C		
		T46	2C		
		T48	2C		
		T5C*			
		T52	2C		
		T54	2C		
		T56	2C		
		T58	2C		
		T6C*			
		T62	2C		
		T64	2C		
		T66	2C		
		T68	2C		
		T7C*			
		T72	2C		
		T74	2C		
		T76	2C		
		T78	2C		
		T8C*			
		T82	2C		
		T84	2C		
		T86	2C		
		T88	2C		
		T9C*			
		T92	2C		
		T94	2C		
		T96	2C		
		T98	2C		
		U2C*			
		U22	2C		
		U24	2C		
		U26	2C		
		U28	2C		
		U3C*			
		U32	2C		
		U34	2C		
		U36	2C		
		U38	2C		
		U4C*			
		U42	2C		
		U44	2C		
		U46	2C		
		U48	2C		
		U5C*			
		U52	2C		
		U54	2C		
		U56	2C		
		U58	2C		
		U6C*			
		U62	2C		
		U64	2C		
		U66	2C		
		U68	2C		
		U7C*			
		U72	2C		
		U74	2C		
		U76	2C		
		U78	2C		
		U8C*			
		U82	2C		
		U84	2C		
		U86	2C		
		U88	2C		
		U9C*			
		U92	2C		
		U94	2C		
		U96	2C		
		U98	2C		
		V2C*			
		V22	2C		
		V24	2C		
		V26	2C		
		V28	2C		
		V3C*			
		V32	2C		
		V34	2C		
		V36	2C		
		V38	2C		
		V4C*			
		V42	2C		
		V44	2C		
		V46	2C		
		V48	2C		
		V5C*			
		V52	2C		
		V54	2C		
		V56	2C		
		V58	2C		
		V6C*			
		V62	2C		
		V64	2C		
		V66	2C		
		V68	2C		
		V7C*			
		V72	2C		
		V74	2C		
		V76	2C		
		V78	2C		
		V8C*			
		V82	2C		
		V84	2C		
		V86	2C		
		V88	2C		
		V9C*			
		V92	2C		
		V94	2C		
		V96	2C		
		V98	2C		
		W2C*			
		W22	2C		
		W24	2C		
		W26	2C		
		W28	2C		
		W3C*			
		W32	2C		
		W34	2C		
		W36	2C		
		W38	2C		
		W4C*			
		W42	2C		
		W44	2C		
		W46	2C		
		W48	2C		
		W5C*			
		W52	2C		
		W54	2C		
		W56	2C		
		W58	2C		
		W6C*			
		W62	2C		
		W64	2C		
		W66	2C		
		W68	2C		
		W7C*			
		W72	2C		
		W74	2C		
		W76	2C		
		W78	2C		
		W8C*			
		W82	2C		
		W84	2C		
		W86	2C		
		W88	2C		
		W9C*			
		W92	2C		
		W94	2C		
		W96	2C		
		W98	2C		
		X2C*			
		X22	2C		
		X24	2C		
		X26	2C		
		X28	2C		
		X3C*			
		X32	2C		
		X34	2C		
		X36	2C		
		X38	2C		
		X4C*			
		X42	2C		
		X44	2C		
		X46	2C		
		X48	2C		
		X5C*			
		X52	2C		
		X54	2C		
		X56	2C		
		X58	2C		
		X6C*			
		X62	2C		
		X64	2C		
		X66	2C		
		X68	2C		
		X7C*			
		X72	2C		
		X74	2C		
		X76	2C		
		X78	2C		
		X8C*			
		X82	2C		
		X84	2C		
		X86	2C		
		X88	2C		
		X9C*			
		X92	2C		
		X94	2C		
		X96	2C		
		X98	2C		
		Y2C*			
		Y22	2C		
		Y24	2C		
		Y26	2C		
		Y28	2C		
		Y3C*			
		Y32	2C		
		Y34	2C		
		Y36	2C		
		Y38	2C		
		Y4C*			
		Y42	2C		
		Y44	2C		
		Y46	2C		
		Y48	2C		
		Y5C*			
		Y52	2C		
		Y54	2C		
		Y56	2C		
		Y58	2C		
		Y6C*			
		Y62	2C		
		Y64	2C		
		Y66	2C		
		Y68	2C		
		Y7C*			
		Y72	2C		
		Y74	2C		
		Y76	2C		
		Y78	2C		
		Y8C*			
		Y82	2C		
		Y84	2C		
		Y86	2C		
		Y88	2C		

Operation: Filling carton with individual tooth powder cans.

Description		
Left Hand	Therblig	Right Hand
Get can of tooth powder	TE, G, TL	Get can of tooth powder
Place in carton	P, A, RL	Place in carton

The underlined therblig performed by the right hand is the start of the work cycle for the purpose of this time analysis.

Figure 4. Workplace for tooth powder packaging.

Operation: Filling carton with individual tooth powder cans.

Description		
Left Hand	Therblig	Right Hand
Get can of tooth powder	TE, G, TL	Get can of tooth powder
Place in carton	P, A, RL	Place in carton

The underlined therblig performed by the right hand is the start of the work cycle for the purpose of this time analysis.

Figure 6. Apparatus for tooth powder packaging.

Table 6

TOOTH POWDER PACKAGING #1

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
602*		540*		368*	
681*		567	27	405*	
730*		619*		439	34
762	32	649	30	560*	
888*		677	28	590	30
927	39	707	30	616	26
976*		735	28	647	31
015	39	764	29	687*	
092*		795	31	718	31
123	31	822	27	761*	
255*		945*		802*	
287	32	976	31	832	30
324	37	004	28	862	30
360	36	035	31	891	29
406*		064	29	929*	
570*		095	31	036*	
601	31	124	29	076*	
635	34	155	31	110	34
670	35	192*		140	30
705	35	222	30	184*	
738	33	255	33	248*	
879*		445*		280	32
918	39	535*		330*	
952	34	570	35	372*	
023*		670*		407	35
123*		702	32	444	37
265*		734	32	475	31
295	30	762	28	611*	
330	35	793	31	645	34
377*		825	32	684*	
415	38	926*		725*	
455	40	957	31	764*	
608*		985	28	795	31
645*		017	32	827	32
686*		055*		857	30
728*		085	30	887	30
761	33	117	32	918	31
805*		147	30	953	35
926*		183	36	984	31
982*		216	33	155*	
		246	30	183	28
		288*		213	30
		425*		247	34
		454	29	287*	
		492*		318	31
		522	30	351	33
		554	32	385	34
		585	31		
		626*			
		685*			
		720	35		
		751	31		
		781	30		
		930*			
		956	26		
		986	30		
Σt	663		1249		884
N	19		41		28
$\bar{t}$	34.895		30.504		31.571

*Cycle time not included because of fumble or irregularly occuring element.

2017 Forest Inventory

Biomass		Preferred Head		Non-Preferred Head	
T	F	T	F	T	F
603*		540*		368*	
681*		867	27	405*	
750*		610*		439	44
762	34	649	30	560*	
820*		677	28	380	20
827	30	707	20	626	26
976*		736	24	647	21
015	36	764	25	857*	
052*		795	21	718	27
183	31	835	27	761*	
285*		848*		92**	
287	32	876	31	838	70
324	37	004	16	862	30
360	36	038	34	391	29
406*		064	29	820*	
570*		095	21	036*	
601	31	124	13	076*	
656	24	185	31	110	24
670	36	192*		140	30
705	35	220	30	164*	
758	33	255	35	248*	
879*		44F*		200	12
912	39	56E*		350*	
982	34	670	36	372*	
025*		670*		407	35
128*		708	28	444	37
26b*		734	32	475	21
28E	30	768	20	61E*	
2E0	38	78E*		645	24
377*		82E		68****	
411	38	85E*		728*	
468	40	89F	21	764*	
60C*		942	1E	798	31
64E*		97Y	1*	82F	32
CE8*		08F*		87F	30
72B*		1EE	1*	91F	30
76F	3*	1F7	2*	91B	21
805*		1E7	30	952	26
81E*		1E5	36	99A	21
85E*		21E	1E	1B8*	
88F		24E	1C	1BF	1E
8E0*		25**		21E	2C
8F4*		26**		24F	2*
92F*		28E	1*	26**	
95E	1*	28F	2*	2E**	
96F	1*	2B8	1C	31E	1*
98E	1*	2EF	1*	35F	1*
9B4		2F1	32	38E	1*
A00*		32**		3B**	
A2F*		34**		3E**	
A4E*		36**		41**	
A6F*		38**		43**	
A8E*		3A**		45**	
AAF*		3C**		47**	
ACE*		3E**		49**	
AEF*		40**		4B**	
B0E*		42**		4D**	
B2F*		44**		4F**	
B4E*		46**		51**	
B6F*		48**		53**	
B8E*		4A**		55**	
BAF*		4C**		57**	
BCE*		4E**		59**	
BEF*		50**		5B**	
C0E*		52**		5D**	
C2F*		54**		5F**	
C4E*		56**		61**	
C6F*		58**		63**	
C8E*		5A**		65**	
CAF*		5C**		67**	
CCE*		5E**		69**	
CEF*		60**		6B**	
D0E*		62**		6D**	
D2F*		64**		6F**	
D4E*		66**		71**	
D6F*		68**		73**	
D8E*		6A**		75**	
DAF*		6C**		77**	
DCE*		6E**		79**	
DEF*		70**		7B**	
E0E*		72**		7D**	
E2F*		74**		7F**	
E4E*		76**		81**	
E6F*		78**		83**	
E8E*		7A**		85**	
EAF*		7C**		87**	
ECE*		7E**		89**	
EEF*		80**		8B**	
F0E*		82**		8D**	
F2F*		84**		8F**	
F4E*		86**		91**	
F6F*		88**		93**	
F8E*		8A**		95**	
FAF*		8C**		97**	
FCE*		8E**		99**	
FEF*		90**		9B**	
100*		92**		9D**	
102*		94**		9F**	
104*		96**		A1**	
106*		98**		A3**	
108*		9A**		A5**	
10A*		9C**		A7**	
10C*		9E**		A9**	
10E*		A0**		AB**	
110*		A2**		AD**	
112*		A4**		AF**	
114*		A6**		B1**	
116*		A8**		B3**	
118*		AA**		B5**	
11A*		AC**		B7**	
11C*		AE**		B9**	
11E*		B0**		BB**	
120*		B2**		BD**	
122*		B4**		BF**	
124*		B6**		C1**	
126*		B8**		C3**	
128*		BA**		C5**	
12A*		BC**		C7**	
12C*		BE**		C9**	
12E*		C0**		CB**	
130*		C2**		CD**	
132*		C4**		CF**	
134*		C6**		D1**	
136*		C8**		D3**	
138*		CA**		D5**	
13A*		CC**		D7**	
13C*		CE**		D9**	
13E*		D0**		DB**	
140*		D2**		DD**	
142*		D4**		DF**	
144*		D6**		E1**	
146*		D8**		E3**	
148*		DA**		E5**	
14A*		DC**		E7**	
14C*		DE**		E9**	
14E*		E0**		EB**	
150*		E2**		ED**	
152*		E4**		EF**	
154*		E6**		F1**	
156*		E8**		F3**	
158*		EA**		F5**	
15A*		EC**		F7**	
15C*		EE**		F9**	
15E*		F0**		FB**	
160*		F2**		FD**	
162*		F4**		FF**	
164*		F6**		101*	
166*		F8**		103*	
168*		FA**		105*	
16A*		FC**		107*	
16C*		FE**		109*	
16E*		100*		10B*	
170*		102*		10D*	
172*		104*		10F*	
174*		106*		111*	
176*		108*		113*	
178*		10A*		115*	
17A*		10C*		117*	
17C*		10E*		119*	
17E*		110*		11B*	
180*		112*		11D*	
182*		114*		11F*	
184*		116*		121*	
186*		118*		123*	
188*		11A*		125*	
18A*		11C*		127*	
18C*		11E*		129*	
18E*		120*		12B*	
190*		122*		12D*	
192*		124*		12F*	
194*		126*		131*	
196*		128*		133*	
198*		12A*		135*	
19A*		12C*		137*	
19C*		12E*		139*	
19E*		130*		13B*	
1A0*		132*		13D*	
1A2*		134*		13F*	
1A4*		136*		141*	
1A6*		138*		143*	
1A8*		13A*		145*	
1AA*		13C*		147*	
1AC*		13E*		149*	
1AE*		140*		14B*	
1B0*		142*		14D*	
1B2*		144*		14F*	
1B4*		146*		151*	
1B6*		148*		153*	
1B8*		14A*		155*	
1BA*		14C*		157*	
1BC*		14E*		159*	
1BE*		150*		15B*	
1C0*		152*		15D*	
1C2*		154*		15F*	
1C4*		156*		161*	
1C6*		158*		163*	
1C8*		15A*		165*	
1CA*		15C*		167*	
1CC*		15E*		169*	
1CE*		160*		16B*	
1D0*		162*		16D*	
1D2*		164*		16F*	
1D4*		166*		171*	
1D6*		168*		173*	
1D8*		16A*		175*	
1DA*		16C*		177*	
1DC*		16E*		179*	
1DE*		170*		17B*	
1E0*		172*		17D*	
1E2*		174*		17F*	
1E4*		176*		181*	
1E6*		178*		183*	
1E8*		17A*		185*	
1EA*		17C*		187*	
1EC*		17E*		189*	
1EE*		180*		18B*	
1F0*		182*		18D*	
1F2*		184*		18F*	
1F4*		186*		191*	
1F6*		188*		193*	
1F8*		18A*		195*	
1FA*		18C*		197*	
1FC*		18E*		199*	
1FE*		190*		19B*	
200*		192*		19D*	
202*		194*		19F*	
204*		196*		1A1*	
206*		198*		1A3*	
208*		19A*		1A5*	
20A*		19C*		1A7*	
20C*		19E*		1A9*	
20E*		1A0*		1AB*	
210*		1A2*		1AD*	
212*		1A4*		1AF*	
214*		1A6*		1B1*	
216*		1A8*		1B3*	
218*		1AA*		1B5*	
21A*		1AC*		1B7*	
21C*		1AE*		1B9*	
21E*		1B0*		1BB*	
220*		1B2*		1BD*	
222*		1B4*		1BF*	
224*		1B6*		1C1*	
226*		1B8*		1C3*	
228*		1BA*		1C5*	
22A*		1BC*		1C7*	
22C*		1BE*		1C9*	
22E*		1C0*		1CB*	
230*		1C2*		1CD*	
232*		1C4*		1CF*	
234*		1C6*		1D1*	
236*		1C8*		1D3*	
238*		1CA*		1D5*	
23A*		1CC*		1D7*	
23C*		1CE*		1D9*	
23E*		1D0*		1DB*	
240*		1D2*		1DD*	
242*		1D4*		1DF*	
244*		1D6*		1E1*	
246*		1D8*		1E3*	
248*		1DA*		1E5*	
24A*		1DC*		1E7*	
24C*		1DE*		1E9*	
24E*		1E0*		1EB*	
250*		1E2*		1ED*	
252*		1E4*		1EF*	
254*		1E6*		1F1*	
256*		1E8*		1F3*	
258*		1EA*		1F5*	
25A*		1EC*		1F7*	
25C*		1EE*		1F9*	
25E*		1F0*		1FB*	
260*		1F2*		1FD*	
262*		1F4*		1FF*	
264*		1F6*		201*	
266*		1F8*		203*	
268*		1FA*		205*	
26A*		1FC*		207*	
26C*		1FE*		209*	
26E*		200*		20B*	
270*		202*		20D*	
272*		204*		20F*	
274*		206*		211*	
276*		208*		213*	
278*		20A*		215*	
27A*		20C*		217*	
27C*		20E*		219*	
27E*		210*		21B*	
280*		212*		21D*	
282*		214*		21F*	
284*		216*		221*	
286*		218*		223*	
288*		21A*		225*	
28A*		21C*		227*	
28C*		21E*		229*	
28E*		220*		22B*	
290*		222*		22D*	
292*		224*		22F*	
294*		226*		231*	
296*		228*		233*	
298*		22A*		235*	
29A*		22C*		237*	
29C*		22E*		239*	
29E*		230*		23B*	
2A0*		232*		23D*	
2A2*		234*		23F*	
2A4*		236*		241*	
2A6*		238*		243*	
2A8*		23A*		245*	
2AA*		23C*		247*	
2AC*		23E*		249*	
2AE*		240*		24B*	
2B0*		242*		24D*	
2B2*		244*		24F*	
2B4*		246*		251*	
2B6*		248*		253*	
2B8*		24A*		255*	
2BA*		24C*		257*	
2BC*		24E*		259*	
2BE*		250*		25B*	
2C0*		252*		25D*	
2C2*		254*		25F*	
2C4*		256*		261*	
2C6*		258*		263*	
2C8*		25A*		265*	
2CA*		25C*		267*	
2CC*		25E*		269*	
2CE*		260*		26B*	
2D0*		262*		26D*	
2D2*		264*		26F*	
2D4*		266*		271*	
2D6*		268*		273*	
2D8*		26A*		275*	
2DA*		26C*		277*	
2DC*		26E*		279*	
2DE*		270*		27B*	
2E0*		272*		27D*	
2E2*		274*		27F*	
2E4*		276*		281*	
2E6*		278*		283*	
2E8*		27A*		285*	
2EA*		27C*		287*	
2EC*		27E*		289*	
2EE*		280*		28B*	
2F0*		282*		28D*	
2F2*		284*		28F*	
2F4*		286*		291*	
2F6*		288*		293*	
2F8*		28A*		295*	
2FA*		28C*		297*	
2FC*		28E*		299*	
2FE*		290*		29B*	
300*		292*		29D*	
302*		294*		29F*	
304*		296*		2A1*	
306*		298*		2A3*	
308*		29A*		2A5*	
30A*		29C*		2A7*	
30C*		29E*		2A9*	
30E*		2A0*		2AB*	
310*		2A2*		2AD*	
312*		2A4*		2AF*	
314*		2A6*		2B1*	
316*		2A8*		2B3*	
318*		2AA*		2B5*	
31A*		2AC*		2B7*	
31C*		2AE*		2B9*	
31E*		2B0*		2BB*	
320*		2B2*		2BD*	
322*		2B4*		2BF*	
324*		2B6*		2C1*	
326*		2B8*		2C3*	
328*		2BA*		2C5*	
32A*		2BC*		2C7*	
32C*		2BE*		2C9*	
32E*		2C0*		2CB*	
330*		2C2*		2CD*	
332*		2C4*		2CF*	
334*		2C6*		2D1*	
336*		2C8*		2D3*	
338*		2CA*		2D5*	
33A*		2CC*		2D7*	
33C*		2CE*		2D9*	
33E*		2D0*		2DB*	
340*		2D2*		2DD*	
342*		2D4*		2DF*	
344*		2D6*		2E1*	
346*		2D8*		2E3*	
348*		2DA*		2E5*	
34A*		2DC*		2E7*	
34C*		2DE*		2E9*	
34E*		2E0*		2EB*	
350*		2E2*		2ED*	
352*		2E4*		2EF*	
354*		2E6*		2F1*	
356*		2E8*		2F3*	
358*		2EA*		2F5*	
35A*		2EC*		2F7*	
35C*		2EE*		2F9*	
35E*		2F0*		2FB*	
360*		2F2*		2FD*	
362*		2F4*		2FF*	
364*		2F6*		301*	
366*		2F8*		303*	
368*		2FA*		305*	
36A*		2FC*		307*	
36C*		2FE*		309*	
36E*		300*		30B*	
370*		302*		30D*	
372*		304*		30F*	
374*		306*		311*	
376*		308*		313*	
378*		30A*		315*	
37A*		30C*		317*	
37C*		30E*		319*	
37E*		310*		31B*	
380*		312*		31D*	
382*		314*		31F*	
384*		316*		321*	
386*		318*		323*	
388*		31A*		325*	
38A*		31C*		327*	
38C*		31E*		329*	
38E*		320*		32B*	
390*		322*		32D*	
392*		324*		32F*	
394*		326*		331*	
396*		328*		333*	
398*		32A*		335*	
39A*		32C*		337*	
39C*		32E*		339*	
39E*		330*		33B*	
3A0*		332*		33D*	
3A2*		334*		33F*	
3A4*		336*		341*	
3A6*		338*		343*	
3A8*		33A*		345*	
3AA*		33C*		347*	
3AC*		33E*		349*	
3AE*		340*		34B*	
3B0*		342*		34D*	
3B2*		344*		34F*	
3B4*		346*		351*	
3B6*		348*		353*	
3B8*		34A*		355*	
3BA*		34C*		357*	
3BC*		34E*		359*	
3BE*		350*		35B*	
3C0*		352*		35D*	
3C2*		354*		35F*	
3C4*		356*		361*	
3C6*		358*		363*	
3C8*		35A*		365*	
3CA*		35C*		367*	
3CC*		35E*		369*	
3CE*		360*		36B*	
3D0*		362*		36D*	
3D2*		364*		36F*	
3D4*		366*		371*	
3D6*		368*		373*	
3D8*		36A*		375*	
3DA*		36C*		377*	
3DC*		36E*		379*	
3DE*		370*		37B*	
3E0*		372*		37D*	
3E2*		374*		37F*	
3E4*		376*		381*	
3E6*		378*		383*	
3E8*		37A*		385*	
3EA*		37C*		387*	
3EC*		37E*		389*	
3EE*		380*		38B*	
3F0*		382*		38D*	
3F2*		384*		38F*	
3F4*		386*		391*	
3F6*		388*		393*	
3F8*		38A*		395*	
3FA*		38C*		397*	
3FC*		38E*		399*	
3FE*		390*		39B*	
400*		392*		39D*	
402*		394*		39F*	
404*		396*		3A1*	
406*		398*		3A3*	
408*		39A*		3A5*	
40A*		39C*		3A7*	
40C*		39E*		3A9*	
40E*		3A0*		3AB*	
410*		3A2*		3AD*	
412*		3A4*		3AF*	
414*		3A6*		3B1*	
416*		3A8*		3B3*	
418*		3AA*		3B5*	
41A*		3AC*		3B7*	
41C*		3AE*		3B9*	
41E*		3B0*		3BB*	
420*		3B2*		3BD*	
422*		3B4*		3BF*	
424*		3B6*		3C1*	
426*		3B8*		3C3*	
428*		3BA*		3C5*	
42A*		3BC*		3C7*	
42C*		3BE*		3C9*	
42E*		3C0*		3CB*	
430*		3C2*		3CD*	
432*		3C4*		3CF*	
434*		3C6*		3D1*	
436*		3C8*		3D3*	
438*		3CA*		3D5*	
43A*		3CC*		3D7*	
43C*		3CE*		3D9*	
43E*		3D0*		3DB*	
440*		3D2*		3DD*	
442*		3D4*		3DF*	
444*		3D6*		3E1*	
446*		3D8*		3E3*	
448*		3DA*		3E5*	
44A*		3DC*		3E7*	
44C*		3DE*		3E9*	
44E*		3E0*		3EB*	
450*		3E2*		3ED*	
452*		3E4*		3EF*	
454*		3E6*		3F1*	
456*		3E8*		3F3*	
458*		3EA*		3F5*	
45A*		3EC*		3F7*	
45C*		3EE*		3F9*	
45E*		3F0*		3FB*	
460*		3F2*		3FD*	
462*		3F4*		3FF*	
464*		3F6*		401*	
466*		3F8*		403*	
468*		3FA*		405*	
46A*		3FC*		407*	
46C*		3FE*		409*	
46E*		400*		40B*	
470*		402*		40D*	
472*		404*		40F*	
474*		406*		411*	
476*		408*		413*	
478*		40A*		415*	
47A*		40C*		417*	
47C*		40E*		419*	
47E*		410*		41B*	
480*		412*		41D*	
482*		414*		41F*	
484*		416*		421*	
486*		418*		423*	
488*		41A*		425*	
48A*		41C*		427*	
48C*		41E*		429*	
48E*		420*		42B*	
490*		422*		42D*	
492*		424*		42F*	
494*		426*		431*	
496*		428*		433*	
498*		42A*		435*	
49A*		42C*		437*	
49C*		42E*		439*	
49E*		430*		43B*	
4A0*		432*		43D*	
4A2*		434*		43F*	
4A4*		436*		441*	
4A6*		438*		443*	
4A8*		43A*		445*	
4AA*		43C*		447*	
4AC*		43E*		449*	
4AE*		440*		44B*	
4B0*		442*		44D*	
4B2*		444*		44F*	
4B4*		446*		451*	
4B6*		448*		453*	
4B8*		44A*		455*	
4BA*		44C*		457*	
4BC*		44E*		459*	
4BE*		450*		45B*	
4C0*		452*		45D*	
4C2*		454*		45F*	
4C4*		456*		461*	
4C6*		458*		463*	
4C8*		45A*		465*	
4CA*		45C*		467*	
4CC*		45E*		469*	
4CE*		460*		46B*	
4D0*		462*		46D*	
4D2*		464*		46F*	
4D4*		466*		471*	
4D6*		468*		473*	
4D8*		46A*		475*	
4DA*		46C*		477*	
4DC*		46E*		479*	
4DE*		470*		47B*	
4E0*		472*		47D*	
4E2*		474*		47F*	
4E4*		476*		481*	
4E6*		478*		483*	
4E8*		47A*		485*	
4EA*		47C*		487*	
4EC*		47E*		489*	
4EE*		480*		48B*	
4F0*		482*		48D*	
4F2*		484*		48F*	
4F4*		486*		491*	
4F6*		488*		493*	
4F8*		48A*		495*	
4FA*		48C*		497*	
4FC*		48E*		499*	
4FE*		490*		49B*	
500*		492*		49D*	
502*		494*		49F*	
504*		496*		4A1*	
506*		498*		4A3*	
508*		49A*		4A5*	
50A*		49C*		4A7*	
50C*		49E*		4A9*	
50E*		4A0*		4AB*	
510*		4A2*		4AD*	
512*		4A4*		4AF*	
514*		4A6*		4B1*	
516*		4A8*		4B3*	
518*		4AA*		4B5*	
51A*		4AC*		4B7*	
51C*		4AE*		4B9*	
51E*		4B0*		4BB*	
520*		4B2*		4BD*	
522*		4B4*		4BF*	
524*		4B6*		4C1*	
526*		4B8*		4C3*	
528*		4BA*		4C5*	
52A*		4BC*		4C7*	
52C*		4BE*		4C9*	
52E*		4C0*		4CB*	
530*		4C2*		4CD*	
532*		4C4*		4CF*	
534*		4C6*		4D1*	
536*		4C8*		4D3*	
538*		4CA*		4D5*	
53A*		4CC*		4D7*	
53C*		4CE*		4D9*	
53E*		4D0*		4DB*	
540*		4D2*		4DD*	
542*		4D4*		4DF*	
544*		4D6*		4E1*	
546*		4D8*		4E3*	
548*		4DA*		4E5*	
54A*		4DC*		4E7*	
54C*		4DE*		4E9*	
54E*		4E0*		4EB*	
550*		4E2*		4ED*	
552*		4E4*		4EF*	
554*		4E6*		4F1*	
556*		4E8*		4F3*	
558*		4EA*		4F5*	
55A*		4EC*		4F7*	
55C*		4EE*		4F9*	
55E*		4F0*		4FB*	
560*		4F2*		4FD*	
562*		4F4*		4FF*	
564*		4F6*		501*	
566*		4F8*		503*	
568*		4FA*		505*	
56A*		4FC*		507*	
56C*		4FE*		509*	
56E*		500*		50B*	
570*		502*		50D*	
572*		504*		50F*	
574*		506*		511*	
576*		508*		513*	
578*		50A*		515*	
57A*		50C*		517*	
57C*		50E*		519*	
57E*		510*		51B*	
580*		512*		51D*	
582*		514*		51F*	
584*		516*		521*	
586*		518*		523*	
588*		51A*		525*	
58A*		51C*		527*	
58C*		51E*		529*	
58E*		520*		52B*	
590*		522*		52D*	
592*		524*		52F*	
594*		526*		531*	
596*		528*		533*	
598*		52A*		535*	
59A*		52C*		537*	
59C*		52E*		539*	
59E*		530*		53B*	
5A0*		532*		53D*	
5A2*		534*		53F*	
5A4*		536*		541*	
5A6*		538*		543*	
5A8*		53A*		545*	
5AA*		53C*		547*	
5AC*		53E*		549*	
5AE*		540*		54B*	
5B0*		542*		54D*	
5B2*		544*		54F*	
5B4*		546*		551*	
5B6*		548*		553*	
5B8*		54A*		555*	
5BA*		54C*		557*	
5BC*		54E*		559*	
5BE*		550*		55B*	
5C0*		552*		55D*	
5C2*		554*		55F*	
5C4*		556*		561*	
5C6*		558*		563*	
5C8*		55A*		565*	
5CA*		55C*		567*	
5CC*		55E*		569*	
5CE*		560*		56B*	
5D0*		562*		56D*	
5D2*		564*		56F*	
5D4*		566*		571*	
5D6*		568*		573*	
5D8*		56A*		575*	
5DA*		56C*		577*	
5DC*		56E*		579*	
5DE*		570*		57B*	
5E0*		572*		57D*	
5E2*		574*		57F*	
5E4*		576*		581*	
5E6*		578*		583*	
5E8*		57A*		585*	
5EA*		57C*		587*	
5EC*		57E*		589*	
5EE*		580*		58B*	
5F0*		582*		58D*	
5F2*		584*		58F*	
5F4*		586*		591*	
5F6*		588*		593*	
5F8*		58A*		595*	
5FA*		58C*		597*	
5FC*		58E*		599*	
5FE*		590*		59B*	
600*		592*		59D*	
602*		594*		59F*	
604*		596*		5A1*	
606*		598*		5A3*	
608*		59A*		5A5*	
60A*		59C*		5A7*	
60C*		59E*		5A9*	
60E*		5A0*		5AB*	
610*		5A2*		5AD*	
612*		5A4*		5AF*	
614*		5A6*		5B1*	
616*		5A8*		5B3*	
618*		5AA*		5B5*	
61A*		5AC*		5B7*	
61C*		5AE*		5B9*	
61E*		5B0*		5BB*	
620*		5B2*		5BD*	
622*		5B4*		5BF*	
624*		5B6*		5C1*	
626*		5B8*		5C3*	
628*		5BA*		5C5*	
62A*		5BC*		5C7*	
62C*		5BE*		5C9*	
62E*		5C0*		5CB*	
630*		5C2*		5CD*	
632*		5C4*		5CF*	
634*		5C6*		5D1*	
636*		5C8*		5D3*	
638*		5CA*		5D5*	
63A*		5CC*		5D7*	
63C*		5CE*		5D9*	
63E*		5D0*		5DB*	
640*		5D2*		5DD*	
642*		5D4*		5DF*	
644*		5D6*		5E1*	
646*		5D8*		5E3*	
648*		5DA*		5E5*	
64A*		5DC*		5E7*	
64C*		5DE*		5E9*	
64E*		5E0*		5EB*	
650*		5E2*		5ED*	
652*		5E4*		5EF*	
654*		5E6*		5F1*	
656*		5E8*		5F3*	
658*		5EA*		5F5*	
65A*		5EC*		5F7*	
65C*		5EE*		5F9*	
65E*		5F0*		5FB*	
660*		5F2*		5FD*	
662*		5F4*		5FF*	
664*		5F6*		601*	
666*		5F8*		603*	
668*		5FA*		605*	
66A*		5FC*		607*	
66C*		5FE*		609*	
66E*		600*		60B*	
670*		602*		60D*	
672*		604*		60F*	
674*		606*		611*	
676*		608*		613*	
678*		60A*		615*	
67A*		60C*		617*	
67C*		60E*		619*	
67E*		610*		61B*	

Table 7

TOOTH POWDER PACKAGING #2

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
620*		425*		355*	
661	41	459	34	392	37
715*		492	33	440*	
785*		525	33	496*	
829	44	558	33	580*	
917*		593	35	625	45
052*		640*		668	43
095	43	675	35	710	42
181*		734*		765*	
245*		767	33	805	40
292	47	803	36	901*	
345*		914*		944	43
480*		947	33	985	41
525	45	980	33	024	39
572	47	018	38	065	41
635*		054	36	123*	
688*		107*		165	42
737	49	151*		206	41
862*		185	34	248	42
901	39	255*		287	39
949	48	295	40	326	39
129*		332	37	365	39
267*		370	38	482*	
310	43	485*		567*	
370*		554*		637*	
418	48	591	37	680	43
474*		627	36	727	47
522	48	666	39	767	40
647*		711*		805	38
690	43	763*		845	40
740	50	855*		885	40
		885	30	930	45
		985*		970	40
		094*		105	35
		132	38	147	42
		170	38	182	35
		197	27	230*	
		232	35	283*	
		270	38	326	43
		299	29	365	39
		345*		438*	
		382	37	490*	
		419	37	532	42
		452	33	574	42
		485	33	640	36
		584*			
		620	36		
		650	30		
		689	39		
		723*			
		760	37		
Σt	635		1190		1259
N	14		34		31
$\bar{t}$	45.357		35.000		40.533

*Cycle time not included because of fumble or irregularly occuring element.

Table V

[illegible]

Bluegrass		Preferred Hard		Non-Preferred Hard	
T	P	T	P	T	P
880*		448		58*	
981	41	489	34	798	27
716*		492	33	440*	
765*		430	30	496*	
582	44	452	33	560*	
317*		503	38	65*	46
080*		440		68	42
095	48	478	34	710	46
131*		484*		705*	
465*		467	32	80*	40
382	47	403	26	905*	
488*		454*		44*	42
480*		947	28	185	41
522	48	680	28	024	38
572	47	316	32	308	41
638*		484	36	1.4*	
686*		137*		148	44
737	49	101*		800	41
882*		188	24	548	42
901	38	880*		487	39
948	48	283	40	528	40
120*		852	37	908	36
284*		370	33	418*	
310	42	418*		80*	
370*		854*		057*	
418	49	892	27	480	44
478*		827	20	727	47
388	46	800	34	707	40
674*		721*		60	38
040	45	702*		48	40
740	50	284*		8.8	40
		842	30	408	41
		424*		040	4
		104*		10*	48
		1.2	36	14*	
		17.	30	18*	48
		111	24	280*	
		488	44	1.8*	
		1 70	28	1 86	46
		48.	14	.0*	47
		748*		4.4*	
		70A	40	1.4*	
		4.	27	2*	
		4.2	22	1.4	
		4.C	1.	4.0	44
		4.4*			
		220	6		
		420			
		4.	1.		
		4.0	1.		
		4.0	4		

Operation: Filling carton with bottles of Halo.

Description		
Left Hand	Therblig	Right Hand
Get bottle of Halo	TE, G, TL	Get bottle of Halo
Place in carton	P, A, RL	Place in carton

The therblig underlined performed by the right hand represents the start of a cycle for the purpose of this time analysis.

Figure 5. Workplace for Packaging Halo.

Operation: Filling carton with bottles of Halo.

Description		
Left Hand	Therblig	Right Hand
Get bottle of Halo	TE, G, TL	Get bottle of Halo
Place in carton	P, A, RL	Place in carton

The therblig underlined performed by the right hand represents the start of a cycle for the purpose of this time analysis.

Figure 9. Workplace for Packaging Halo.

Table 8

HALO PACKAGING

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
499*		872*		890*	
544	45	911	39	931	41
673*		960*		973	42
712	39	040*		040*	
756	44	085	45	090*	
795	39	124	39	132	42
835	40	257*		170	38
878	43	300	43	220*	
136*		337	37	282*	
185	49	372	35	333*	
218	33	423*		388*	
258	40	459	36	523*	
302	44	498	39	563	40
422*		540	42	610	47
460	38	578	38	652	42
502	42	624	46	717*	
542	40	664	40	757	40
582	40	699	35	808*	
628	46	828*		847	39
754*		878*		905*	
796	42	916	38	960*	
842	46	955	39	010*	
880	38	008*		065*	
920	40	046	38	227*	
979*		085	39	265	38
107*		122	37	307	42
148	41	235*		347	40
189	41	274	39	459*	
226	37	312	38	495	36
264	38	438*		540	45
310	46	474	36	575	35
417*		513	39	618	43
454	37	549	36		
528*		599*			
564	36	636	37		
603	39	673	37		
656*		711	38		
796*		748	37		
836	40	790	42		
877	41	827	37		
917	40	863	37		
960	43	003	40		
007	47	037	34		
131*		068	31		
172	41	102	34		
216	44				
263	47				
310	47				
357	47				
Σt	1540		1297		650
N	37		34		16
$\bar{t}$	41.621		38.147		40.625

*Cycle time not included because of fumble or irregularly occuring element.

Table 8

MALE / FEMALE

Humanity		Preferred Hand		Non-Preferred Hand	
♂	♀	♂	♀	♂	♀
499*		878*		890*	
544	46	911	56	931	41
673*		980*		972	48
715	52	040*		040*	
756	44	085	46	090*	
798	39	124	50	155	45
836	40	287*		177	58
878	45	300	43	1[illegible]*	
136*		337	37	182*	
198	40	372	36	236*	
218	36	442*		288*	
258	40	489	36	342*	
302	44	492	39	395	40
424*		540	42	510	47
460	38	572	38	552	44
502	42	634	46	717*	
542	40	664	40	767	40
582	40	690	35	808*	
628	46	742*		864	39
684*		778*		908*	
726	42	816	38	980*	
842	46	886	50	010*	
880	38	008*		060*	
920	40	048	38	227*	
978*		086	38	285	58
1072*		122	37	307	44
1146	41	225*		347	40
1184	41	274	39	382*	
1240	37	312	38	426	36
1264	30	438*		460	48
1310	46	474	36	575	35
1374		513	39	618	43
1434	37	540	36		
1528*		578*			
1564	36	636	37		
1604	39	678	37		
1644		721	38		
1698*		758	37		
1740	40	800	42		
1784	41	842	42		
1824	40	882	40		
1864	40	922	40		
1904	40	962	40		

Operation: Assembling faucet sub-assembly.

Description

Left Hand	Therblig	Right Hand
Get saw	TE, G, P	Get saw
Assemble with fixture	A, RL	Assemble with fixture
Get washer	TE, G, TL	Get washer
Assemble with screw	P, A, RL	Assemble with screw
Get swivel	TE, G, P	Get swivel
Assemble with screw	A, RL	Assemble with screw
Disassemble from fixture	TE, G, TL	Disassemble from fixture
Assemble with tightening board	P, A, RL	Assemble with tightening board

The underlined Therblig represents the performed act by the right hand beginning a cycle for the purposes of this time analysis.

Figure 6. Workplace for assembling faucet sub-assemblies.

Operation: Assembling fusee sub-assembly.

Description

Left Hand	Therblig	Right Hand
Get saw	TE, G, P	Get saw
Assemble with fixture	A, RL	Assemble with fixture
Get washer	TE, G, TL	Get washer
Assemble with screw	P, A, RL	Assemble with screw
Get swivel	TE, G, P	Get swivel
Assemble with screw	A, RL	Assemble with screw
Disassemble from fixture	TE, G, TL	Disassemble from fixture
Assemble with tighten-ing board	P, A, RL	Assemble with tighten-ing board

The underlined Therblig represents the performed act by the right hand beginning a cycle for the purposes of this time analysis.

Figure 6. Workplace for assembling fusee sub-assemblies.

Table 9

FAUCET SUB-ASSEMBLY

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
238*		118*		988*	
501	263	372	254	212	224
725	224	590	218	436	224
980	255	808	218	662	226
259	271	043	235	876	214
495	236	308*		160*	
759	264	511	203		
024	265	725	214		
426*		922	197		
696	270	317*			
985*		530	213		
410*		796*			
700*		035	239		
926	226	284	249		
140	214	456*			
391	251	741*			
689*		770*			
065*		981	211		
328	263				
626*					
Σt	3002		2451		888
N	12		11		4
$\bar{t}$	250.167		222.154		222.000

*Cycle time not included because of fumble or irregularly occuring element.

Table 9

FAUCET SUB-ASSEMBLY

Primarily		Preferred Hand		Non-Preferred Hand	
T	F	T	F	T	F
258*		118*		960*	
601	265	272	254	212	284
748	284	680	218	436	284
960	285	608	218	682	288
280	271	042	288	870	274
486	286	304*		180*	
780	264	611	202		
084	268	728	214		
420*		682	197		
006	270	37?*			
088*		650	212		
410*		78?*			
700*		062	288		
926	286	284	242		
140	214	452*			
321	281	74?*			
080*		720*			
068*		681	211		
288	262				
628*					

Σf	2008	2481	888
N	12	11	4
$\bar{f}$	850.167	222.184	222.000

*Cycle time not included because of "mbl" or irregularity occurring element E.

Operation: Assembling watt-hour meter sub-assembly.

Description

Left Hand	Therblig	Right Hand
Get sleeve	TE, G, TL	Get sleeve
Assemble with fixture	P, A, RL	Assemble with fixture
Get washer	TE, G, TL	Get washer
Assemble with fixture	P, A, RL	Assemble with fixture
Get screw	TE, G, TL	Get screw
Assemble with sleeve and washer	P, A, RL	Assemble with sleeve and washer
	DA, RL	Trip fixture release

The therblig underlined performed by the right hand represents the beginning of a cycle for the purpose of this time analysis.

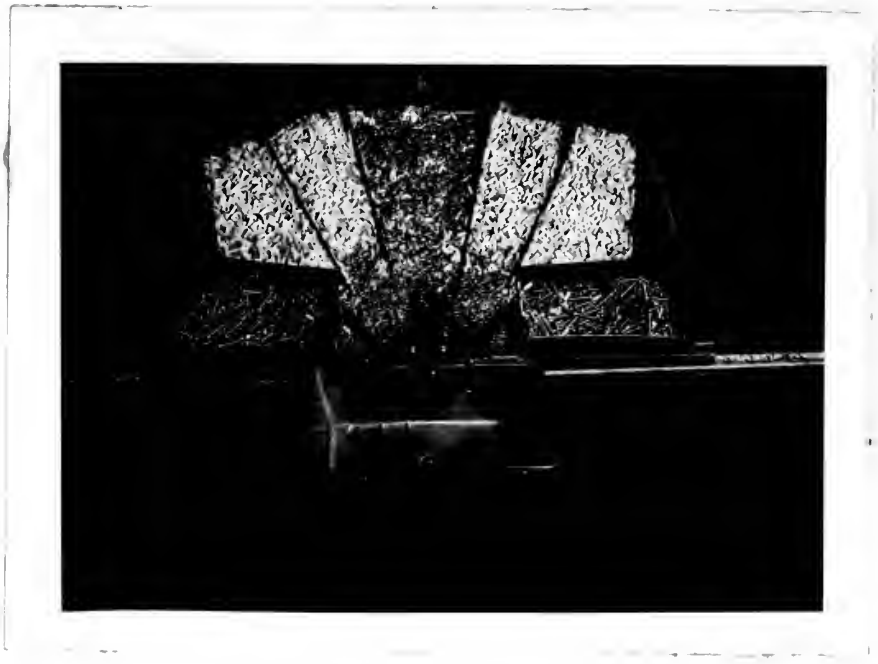

Figure 7. Workplace for assembling watt-hour meter sub-assembly.

Operation: Assembling wet-pour meter sub-assembly.

Description

Left Hand	Threefig	Right Hand
Get sleeve	TE, G, TL	Get sleeve
Assemble with fixture	P, A, RL	Assemble with fixture
Get washer	TE, G, TL	Get washer
Assemble with fixture	P, A, RL	Assemble with fixture
Get screw	TE, G, TL	Get screw
Assemble with sleeve and washer	P, A, RL	Assemble with sleeve and washer
	DA, RL	Trip fixture release

The threefig underlined performed by the right hand represents the beginning of a cycle for the purpose of this time analysis.

Figure 7. Workplace for assembling wet-pour meter sub-assembly.

Table 10

ASSEMBLING SLEEVE AND WASHER TO BOLT

Bimanually		Preferred Hand		Non-Preferred Hand	
T	t	T	t	T	t
750*		037*		707*	
918	168	235	198	874	167
135	217	427	192	054	180
352*		553	126	179	125
598*		740	187	316	137
788	190	867	127	483	167
009	221	135	168	645	162
152	143	255*		810	165
556*		430	175	958	148
775	219	586	156	093	135
915	140	740	154	231	138
084	169	874	136	380	149
239	155	059	185	526	146
385	146	237	178	654	128
580	195	704*		785	131
791	211	874	170	930	145
960	169	015	141	111	181
103	143	152	137	647*	
338*		304	152	867*	
496	158	456	152	996	129
656	160	617	161	177	181
841	185	742	125	326	149
011	170	876	134	480	154
211	200	012	136		
770*					
946	176				
089	143				
234	145				
431	197				
601	171				
805	204				
009	204				
237*					
404	167				
594	190				
775	181				
962	187				
139	177				
Σt	5501		3290		3017
N	31		21		20
$\bar{t}$	177.452		156.667		150.850

*Cycle time not included because of fumble or irregularly occuring element.

Table 10

ASSESSING SUBURB AND AGE

Bilingual		Preferred Head		Non-preferred Head	
T	t	T	t	T	t
780*		0[illegible]		797	
918	1.88	2[illegible]	1.08	874	1.67
1.0[illegible]	817	4.37	1.08	084	1.80
586*		888	1.46	1.70	1.88
808*		7.0	1.7	810	1.27
708	1.80	8.07	1.27	402	1.87
009	881	1.80	1.08	840	1.68
1.8[illegible]	1.48	2.48[illegible]		81.[illegible]	1.68
880*		4.0[illegible]	1.78	870	1.48
776	818	868	1.80	[illegible]87	1.78
81[illegible]	1.80	780	1.84	87[illegible]	1.88
084	1.80	8.74	1.80	[illegible]80	1.48
884	1.08	0.08	1.8[illegible]	880	1.40
888	1.40	4.87	1.78	884	1.08
880	1.88	7.0**		788	1.81
781	811	2.74	1.70	870	1.48
900	1.88	01[illegible]	1.41	811	1.81
1.08	1.48	1.88[illegible]	1.87	8.7*	
2.8*		4.[illegible]	1.82	8.7*	
488	1.08	4.[illegible]	1.82	7.8	1.89
08[illegible]	1.80	C.[illegible]	1.81	1.77	1.81
881	1.88	7.[illegible]	1.88	8.8	1.48
011	1.70	4.0[illegible]	1.4	4.0	1.4
1.[illegible]	800	[illegible]7	1.88		
770*					
04[illegible]	1.70				
[illegible]8	[illegible]4				
4.8	1.48				
[illegible]7	[illegible]7				
[illegible]0	1.7[illegible]				
[illegible]08	2.8				
00[illegible]	1.04				
[illegible]4*					
4.4	1.87				
1.4[illegible]	1.80				
778	1.4[illegible]				
88[illegible]	1.7[illegible]				
1.8	1.7*				

[illegible]

Table 11

CALCULATION OF N^1

Operation	Operator		Σt	Σt^2	$N\Sigma t^2$
1	1	Preferred Hand	865	26921	753788
		Non-preferred	1205	38459	1461442
		Bimanually	792	28716	631752
	2	Preferred Hand	1082	30644	1164472
		Non-preferred	1046	29916	1106892
		Bimanually	1133	39391	1299903
	3	Preferred Hand	1289	43515	1697085
		Non-preferred	1125	37791	1284894
		Bimanually	1204	48692	1460760
2	1	Preferred Hand	1249	38235	1567635
		Non-preferred	884	28064	785792
		Bimanually	663	23307	442833
	2	Preferred Hand	1190	41960	1426640
		Non-preferred	1216	49486	1484580
		Bimanually	635	28941	405174
3	1	Preferred Hand	1297	49779	1692486
		Non-preferred	650	26550	424800
		Bimanually	1540	64586	2389682
4	1	Preferred Hand	2888	549615	60457650
		Non-preferred	888		
		Bimanually	3002	755370	9064440
5	1	Preferred Hand	3017	461381	9227620
		Non-preferred	3290	526104	11048184
		Bimanually	5501	994191	30819921

			$(\Sigma t)^2$	$N\Sigma t^2 - (\Sigma t)^2$	N	N^1
1	1	Preferred Hand	748225	5563	28	11.9
		Non-preferred	1452025	9417	38	10.4
		Bimanually	627264	4488	22	11.4
	2	Preferred Hand	1149184	15288	38	20.9
		Non-preferred	1094116	12776	37	18.7
		Bimanually	1283689	16214	33	20.25
	3	Preferred Hand	1661521	35564	39	34.3
		Non-preferred	1265625	19269	34	24.3
		Bimanually	1449616	11144	30	12.3
2	1	Preferred Hand	1560001	7634	41	7.9
		Non-preferred	781456	4336	28	10.0
		Bimanually	439569	3264	19	11.9
	2	Preferred Hand	1416100	10540	34	11.9
		Non-preferred	1478656	5924	30	6.4
		Bimanually	403225	1949	14	7.4
3	1	Preferred Hand	1682209	10277	34	10.1
		Non-preferred	422500	2300	16	8.7
		Bimanually	2371600	18082	37	12.2

Table 11

[illegible] 1/

Chapter	Occupation				
1	1	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
		Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
	2	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
2	1	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
	2	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
3	1	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
4	1	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]
5	1	Preferred [illegible]	[illegible]	[illegible]	[illegible]
		Non-preferred	[illegible]	[illegible]	[illegible]
		Diminutive	[illegible]	[illegible]	[illegible]

[illegible]

1		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
2		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
3		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]

Table 11 (Continued)

Operation	Operator		$(\Sigma t)^2$	$N\Sigma t^2 - (\Sigma t)^2$	N	N^1
4	1	Preferred Hand	6007401	38364	11	10.1
		Non-preferred			4	
		Bimanually	9012004	52436	12	9.3
5	1	Preferred Hand	9102289	125331	20	22
		Non-preferred	1082410	224084	21	33
		Bimanually	30261001	558920	31	29.4

Table II (Continued)

Operation	Operator		$(\Sigma t)_s$	$k(\Sigma t)_s^*$	n	λ_7
4	1	Preferred Hand Non-preferred Ultimately	60074OI 30I8OO4	58856 58456	11 4 12	10.1 9.3
5	1	Preferred Hand Non-preferred Ultimately	8IO8289 I0894IO 2O8QIOOI	I58837 52408 58888O	20 21 81	38 53 58.4

Table 12

COMPUTATION OF CORRELATION COEFFICIENT
BETWEEN MEAN CYCLE TIMES FOR PREFERRED HAND OPERATION
AND PERCENT INCREASE IN CYCLE TIME FOR BIMANUAL OPERATION

Operation	Operator	Cycle Time	Percent Increase
		x	y
1	1	30.893	16.531
	2	28.210	21.705
	3	33.051	21.427
2	1	30.463	14.549
	2	35.000	29.591
3	1	38.147	9.107
4	1	222.818	12.610
5	1	150.850	17.635

Σx	569.432	Σy	143.155
Σx^2	78829.607	Σy^2	2843.741
$\Sigma x \Sigma y$	81325.709	Σxy	9127.445

Line of Least Squares.

a = slope = $\frac{N\Sigma xy - \Sigma x \Sigma y}{N\Sigma x^2 - (\Sigma x)^2}$ = -.027

b = y intercept = $\frac{\Sigma x^2 \Sigma y - \Sigma x \Sigma xy}{N\Sigma x^2 - (\Sigma x)^2}$ = 15.972

Table 12

COMPUTATION OF CORRELATION COEFFICIENT
BETWEEN MAN CYCLE TIMES FOR PREVAILED HAND OPERATION
AND PERCENT INCREASE IN CYCLE TIME FOR MANUAL OPERATION

Operation	Operator	Cycle Time x	Percent Increase y
1	1	30.889	16.381
	2	28.210	21.705
	3	35.081	21.427
2	1	30.465	14.849
	2	35.000	29.381
3	1	38.147	9.107
4	1	222.818	12.810
5	1	180.880	17.685

Σx 589.432 Σy 143.158

Σx^2 78829.807 S_x Σy^2 2843.741

Σxy 8187.445

Line of Least Squares.

$$a = \text{slope} = \frac{N\Sigma xy - \Sigma x \Sigma y}{N\Sigma x^2 - (\Sigma x)^2} = -.027$$

$$b = y \text{ intercept} = \frac{\Sigma x^2 \Sigma y - \Sigma x \Sigma xy}{N\Sigma x^2 - (\Sigma x)^2} = 18.978$$

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An analysis of some differences between one and two-handed industrial work.